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THE NEW ITALIAN WAR STEAMER "DUILIO."

We illustrate the most powerful war ship afloat, if her offensive and defensive capabilities are to be estimated on the basis of the modern theory of naval actions. The Duilio is one of four enormous vessels which are intended to render Italy a first-class naval power. The remaining three ships are the Dandolo, the Lepanto, and the Italia. For nearly all the following particulars concerning these ships we are indebted to Mr. King's admirable "Report on European Ships of War."

The Duilio was launched in May, 1876, having been laid down at Castellamare in 1872; she very much resembles our own Inflexible and she possesses just the same defects—if defects they can be called—as those which Mr. Reed asserts the first-named ship to have.

The hull is built of iron and steel, on the cellular system. The double bottom extends for upward of 230 ft. in length, and is divided both longitudinally and transversely into a great number of water-tight compartments. Each compartment is provided with a branch tube which is connected with one principal tube in communication with powerful steam pumps. The tubes are, of course, fitted with the necessary valves, so that in the event of damage to the bottom of the vessel, or for any desirable purpose, any one or more of the compartments may be drained or filled with water. There is a central armored citadel or compartment 107 ft. in length and 58 ft. in breadth, which descends to 5 ft. 11 ins. below the load water line. It protects the machinery and boilers, the magazines and shell rooms, and a portion of the machinery for working the turrets and guns. Forward and aft of this citadel the decks, which are 4 ft. 9 ins. under water, are defended by horizontal armor. Over this citadel is built a second central armored compartment, which incloses the bases of the turrets and the remaining portion of the mechanism employed in loading and working the guns. Lastly, above this second compartment rise the two turrets. The position of the turrets in the Duilio was made the subject of a novel arrangement, and one which was tried for the first time in that vessel. They are placed at each end of the central armored citadel—not in an even line with each other, but diagonally at opposite corners of it, with the centers at the distance of 7 ft. 8 ins. from the longitudinal center line of the vessel, so that one turret is on the starboard side and the other on the port side. The effect of this arrangement is to render possible the discharge of three guns simultaneously in a direction parallel with the keel. Only the central portion of the ship and the two turrets will be protected by vertical armor.

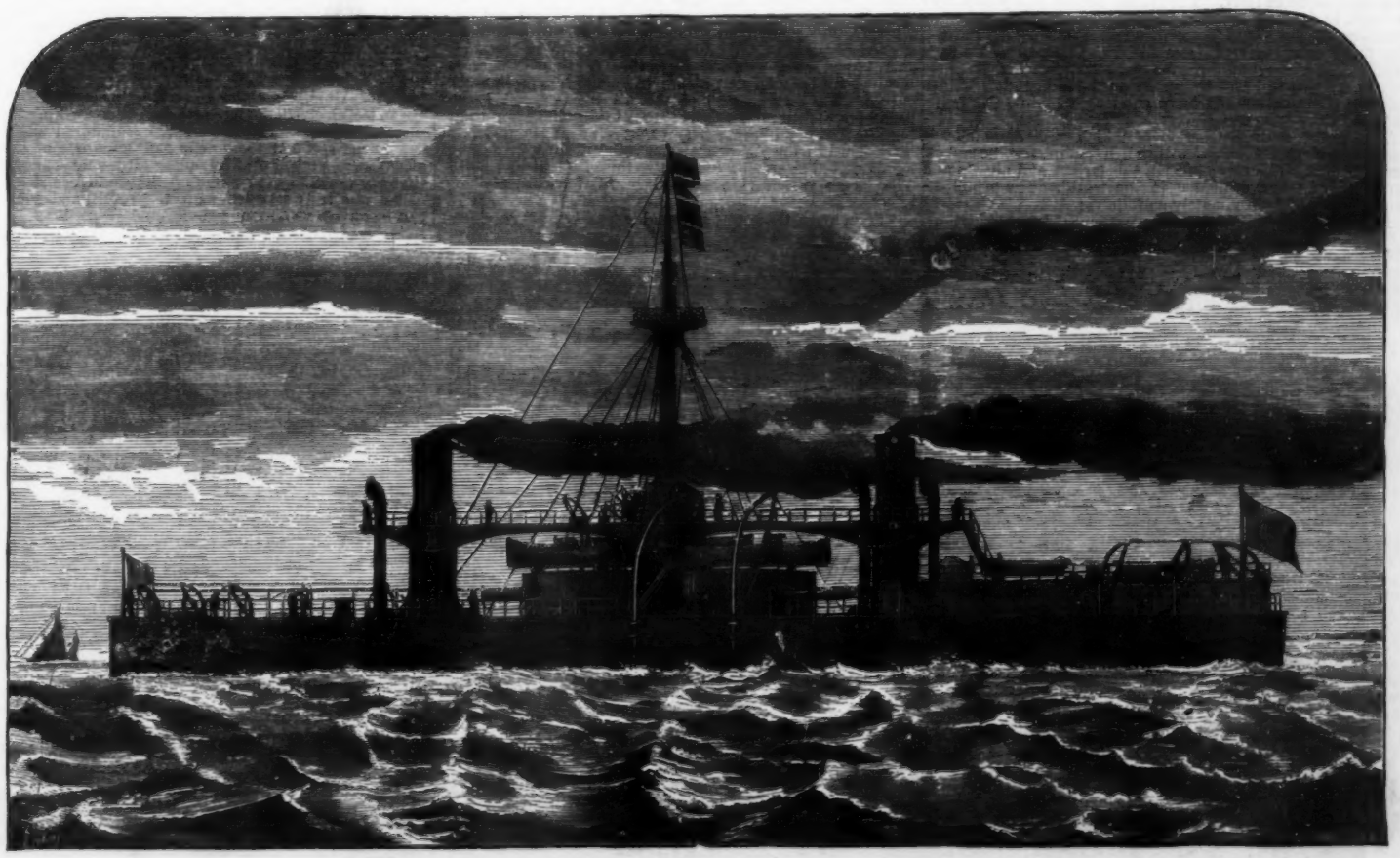
The results of the experiments at Spezia induced the Italian Government to adopt steel for armor in preference to iron. They were led to this determination for the reason that the projectiles fired from the 100-ton gun failed to pass through a target faced with 22 ins. of that metal, while similar projectiles from the same gun perforated targets composed of iron plates of the same thickness. They are at the present time engaged in plating the Duilio and Dandolo with armor of this material. The gun is built up according to the well-known Armstrong system, the inner barrel or tube being of steel, rifled with twenty-seven grooves, the spaces between which are nearly equal to the width of the grooves themselves. The rifling has an increasing pitch, commencing at the chamber with 1 in 150 calibers, and increased to 1 in 50 calibers. The depth of the grooves is 1/4 in. throughout. The steel barrel is 31 ft. 3 ins. long, 6 ins. thick at the powder chamber, diminishing to 3 1/2 ins. at the muzzle. It is bound by successive layers of wrought-iron coiled cylinders. There are ten of these coils, and they are so arranged as to interlock with and overlap each other at their junctions; six of them are on the rear half of the gun, the remaining four being placed singly end to end around the tube. The first coil at the rear is 13 ft. long by 7 ins. thick; over this is a coil 8 ins. thick and 9 ft. 6 ins. in length; then the trunnion coil, which is 11 ins. thick and 2 ft. long; forward of this is a tapered coil, having an average thickness of 6 1/2 ins. and a length of 3 ft. 3 ins. Outside of the second long coil is another to the rear, 9 ins. thick and 5 ft. 6 ins. long. Thus the breech portion is bound by three coils, the trunnion portion by two and the forward portion by one. The trunnions, it may be observed, are not placed on the largest diameter of the gun, but further forward, where the diameter is considerably reduced. There is consequently a preponderance of weight at the breech end of about four tons, which gives stability in working, inasmuch as the weight is always tending in one direction. The exact weight of the gun is 101 1/2 tons, its extreme length is 32 ft. 10 1/2 ins., the length of the bore is 30 ft. 6 ins., and its diameter is 17 ins. The outside diameter of the gun at the muzzle is 29 ins. and at the breech it is 77 ins. The weight of the projectile is 2,000 lbs. and that of the proof shot 2,500 lbs. Rotation is given to the projectile, not by the usual studs fixed in the projectiles to fit the grooves, but by a copper gas check fixed into the rear end of the shell, and which has projections upon it corresponding with the rifling grooves of the gun; the shell is so formed that the check, on being crushed against it by the pressure of the explosion of the charge, presses firmly about it; and the gas check being caused to rotate by the rifling grooves, causes the projectile to turn and to take the same rotation. The cartridge measures 52 ins. in length by 15 1/2 ins. in diameter.

DIMENSIONS, WEIGHTS, ETC.

	Duilio and Dandolo.
Year in which their construction was commenced	1872 and 1873.
Year in which they will be entirely completed	1878 and 1879.
Navy-yards in which they are building	Castellamare and Spezia.
Navy-yard in which they will be completed	Spezia.
Material of which the vessels are built	Iron.
Number of compartments into which each vessel is divided	102
Weight of hull alone, in tons	3,395·5
Length between perpendiculars, in feet and inches	340 11
Breadth of beam, extreme, in feet and inches	64 9
Depth of hold, in feet and inches	21 11
Draught of water, forward, in feet and inches	25 5
Draught of water, aft, in feet and inches	26 5
Displacement at deep load-line in tons	10,401
Area of immersed midship section, in square feet	1,466·6
Projection of ram forward of perpendicular, in feet	9
Immersion of the same at deep load-line, in feet	14
Number of turrets	2
System of turrets	Revolving.
Diameter of interior of turrets, in feet and inches	25·9
Thickness of armor at water-line, in inches	21·65
Thickness of armor at upper redoubt, in inches	17·71
Thickness of armor of turrets, in inches	17·71
Thickness of backing of wood at water-line, in inches	23·63
Thickness of backing of wood at upper redoubt, in inches	19·68
Thickness of wood backing of turrets, in inches	11·81
Depth of immersion of armor, in feet and inches	5·3
Total weight of armor, in tons	2,559
Total weight of wood backing, in tons	239

NUMBER OF GUNS AND THEIR WEIGHTS.

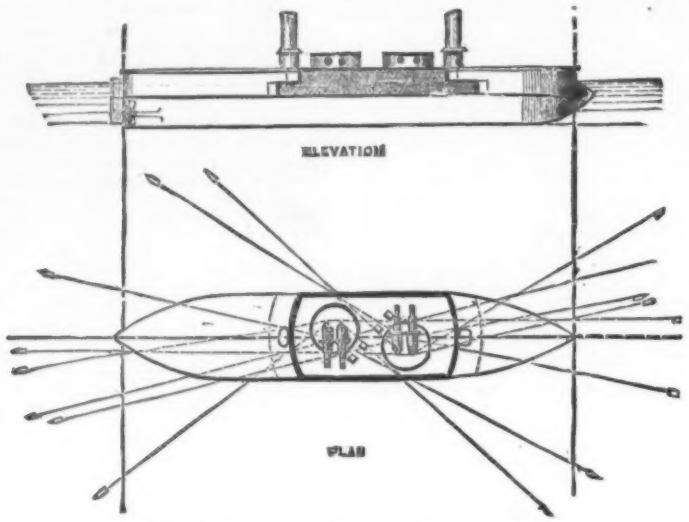
	Duilio and Dandolo.
Number of guns	4
Weight of each gun, in tons	98·5
Weight of broadside metal, in tons	3·87
Weight of bow-fire metal, in tons	2·9
Weight of stern-fire metal, in tons	1·93
Total weight of guns, their machinery, and ammunition, in tons	984·3
Height of main deck above water, in feet and inches	11 6
Height of battery, in feet and inches	15 9
Estimated cost of each ship, in dollars (gold), exclusive of armament and outfit	2,818,800



THE NEW ITALIAN WAR STEAMER DUILIO.

MACHINERY.

	Duilio. Ordinary.	Dandolo. Compound.
Kind of engines		
Name of constructor	Penn.	Maudslay.
Indicated horse-power, contract	7,500	7,900
Number of cylinders	4	4
Diameter of cylinders, in inches	93·5	64 & 120
Stroke of pistons, in inches	39	48
Number of revolutions of engines per minute, estimated	65	80
Number of screw propellers	2	2



ITALIAN WAR STEAMER "DUILIO."

Diameter of screw propellers, in feet and inches	17 3	16 0
Pitch of screw propellers, in feet and inches	19 6	19 0
Speed of ships, in knots, estimated	14	14
Number of boilers	10	8
Number of furnaces	40	32
Grate surface, in square feet	899·6	811·6
Heating surface, in square feet	23,755	22,991
Boiler pressure in pounds	30	60
Number of smoke pipes	2	2
Tons of coal to be carried in bunkers	1,279	1,279

The Duilio is to be armed with a heavy projecting ram, and she is also to be provided with apparatus for discharging the Whitehead fish torpedoes. Besides these powerful means of offense, there is to be a novel and original arrangement of carrying a rapid torpedo boat; this boat is to be inclosed at the stern in a tunnel secured by a grated door, and when necessary can be launched and started on its course against an enemy's vessel. The ship is to be driven by twin screws. The motive machinery is furnished by Messrs. John Penn & Sons, of Greenwich, England, and consists of his old type, a pair of trunk engines to each screw. The steam will be supplied by ordinary box boilers. The two sets of engines are designed to develop the aggregate power of 7,500 horses, and the estimated speed of the vessel on the measured mile is 14 knots per hour. The heavy forgings for the ship were made in Italy. The frame, beams, and plates for the hull, in fact, all the iron and steel entering into the construction of the vessel, were made in France. All the armor plates were ordered from Messrs. Cammell & Co., of Sheffield, England, and the guns and machinery for working them were also to be of English manufacture, thus leaving only the construction and labor entering therein to be performed by the Italian engineers.

The Italia, the construction of which was commenced last year at Castellamare, will, when completed, be a stupendous floating battery; indeed, the largest and most powerful ship of war ever floated in the world. The principal dimensions are approximately as follows:

Length, 400 feet 3 inches; beam, extreme, 73 feet 10 inches; draught of water forward, 25 feet 4 inches; aft, 30 feet 4 inches; height of upper deck above keel, 49 feet 3 inches; displacement, 13,480 tons; weight of unarmored hull, 5,000 tons; area of midship section, 1,848 square feet. The double bottom of the ship is 254 feet 3 inches long, 59 feet wide, and 3 feet 3 inches deep, and is divided into a large number of water-tight cells. Two longitudinal bulkheads extend from stem to stern, and the ship is divided by means of these and transverse bulkheads into fifty-three water-tight compartments, forty of the latter being above the double bottom of the vessel, three in the rear, and ten forward of it. These compartments are again divided horizontally by four water-tight decks; of these, the lowest, which is to be armored with iron 3 inches thick, is about 8 feet 2 inches below the water-line; the second, 5 feet above the line of flotation; the battery deck, 14 feet 9 inches, and the upper deck, 21 feet 4 inches above the water line. On the upper deck stands an armored redoubt, of oval form, its longer axis being at an angle of about 20 degrees to the keel, and within it will be the turrets containing the guns. The armor will be mainly disposed in the form of a girdle around the ship, extending from the deck below to the first deck above the water line. From this latter deck to the upper one the sides of the ship will be consequently unprotected; but the lower smoke pipes, and also the tubes up which the ammunition is passed from the magazine to the redoubt, will be armored. The ship will be driven by twin screws, each 19 feet 6½ inches in diameter, worked by four engines capable of developing 18,000 horse-power, and propelling the vessel through the water at the estimated speed of 16 knots per hour. It is reported that the guns are to be of the Armstrong manufacture, and each is to weigh 100 tons; whether a greater number is to be carried than on the Duilio is, perhaps, not yet fully settled.—*Engineer.*

RECENT TORPEDO EXPERIMENTS.

OUR engraving represents some of the torpedo experiments lately made off Portland, England, by the British Government.

"For more than an hour," says the London *Graphic*, "there were sounds of bugles on all the ships composing the splendid fleet now assembled here. The Blazer and Bustard got under way, and a number of small steam launches cruised about with a red torpedo fastened to an enormous spar, lashed amidships, and projecting far beyond the bows. We had not long to wait before tremendous explosions occurred. The water flew into the air like Crystal Palace fountains, and the time which it took to descend proved how high its flight had been. The yacht felt as if she had been hit violently from below by some of Vulcan's own giant hammers. The smaller boats were tossed about like corks. The larger vessels (I afterward heard) felt scarcely any effect.

"Soon after there was a second explosion, not so violent as the first, from what appeared to be a different sort of torpedo. After that the boats returned to their respective quarters, there was a Royal salute, and all was quiet. Since then the children have been out in the dingey collecting hundreds of little fish killed by the explosion."

A very successful experiment of blowing up an abandoned hulk with torpedoes took place at Willetts' Point, near this city, August 7th. General Abbot, commander of the Government station, desiring photographic views of the effects of torpedo explosions at various depths, singly and in combination, torpedoes were electrically fired by means of keys in the observatory and laboratory, while along the shore at the point were arranged electrical cameras, with electric chronometric attachments. These were so arranged that the prepared plates could be dropped instantaneously by electric fuses and when dropped would register by the chronometric attachment the exact time the photographs were taken. Various photographs of the single torpedo experiments were taken, so that the form of the jets cast up by the explosions at different depths might be clearly seen.

The grand experiment of the day, however, was tried in the afternoon, when Gen. Abbot obtained one of the most valuable photographs—that of the appearance of a vessel at the moment it is being blown up by a submerged torpedo. This feat has never hitherto been successfully accomplished. The General has employed for some time in his experiments a 100-ton schooner called the Royal George, which had become useless for such service, and was at length sacrificed in the cause which it had so long served.

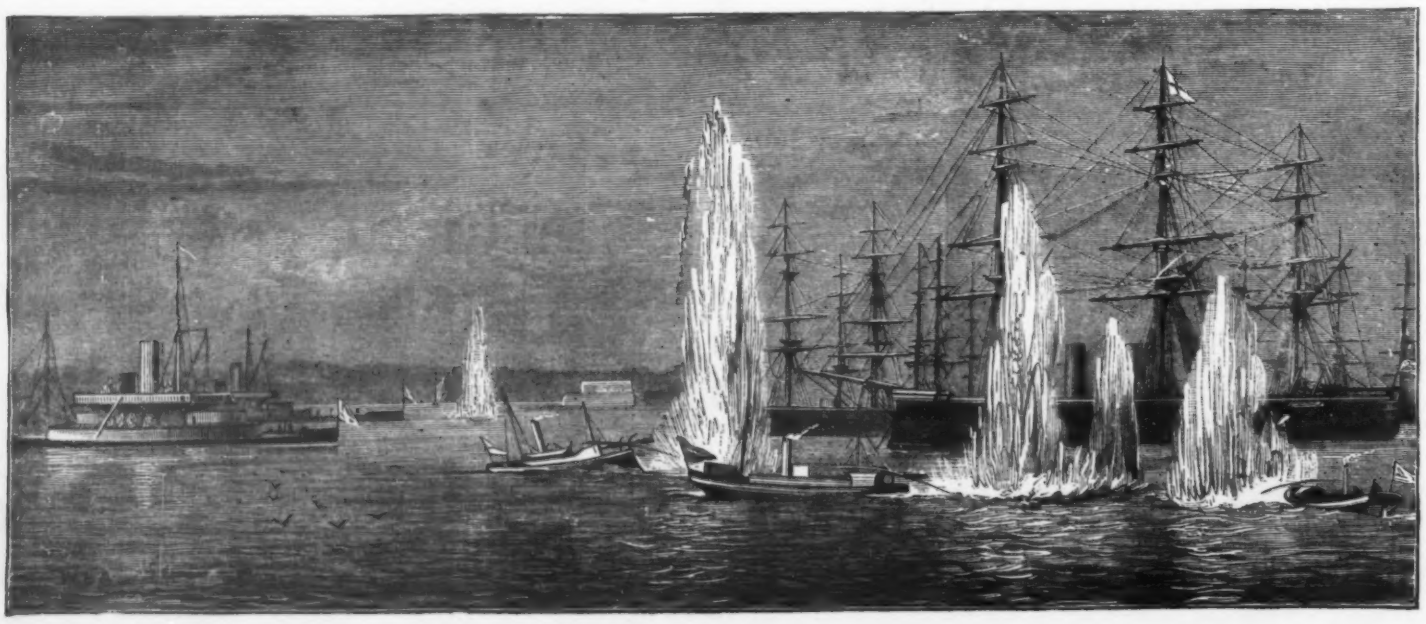
About noon four photographic instruments, a small but very fine and scientific clock, an electric battery, and all the machinery necessary for a telegraph office, were put in position at the end of the pier. There were also two small beer kegs, coated outside with pitch, and a large coil of submarine cable. The kegs, each of which contained 50 pounds of powder, were taken out near the vessel in a row boat, and both sunk—one about 20 feet from the vessel's bow, the other as far from her stern. They were connected with the cable, the boat got out of the way, and the torpedoes were fired, one at a time, by the simple telegraph key on the pier. Each of them sent a column of water into the air about 50 feet high, which immediately relapsed into nothingness, but no damage was done to the schooner. Then two more torpedoes were sent out and connected with the cable at about the same distances from the schooner as before. These were fired simultaneously, with the same result as to churning and hoisting the water, but again without injuring the vessel.

The very simple electrical apparatus for taking photographs of moving bodies was put in order. The four photographic instruments were put in line, each pointing at the fated schooner. Over them was a light wooden framework, from which were suspended four light boards, like shingles, so arranged that when they dropped they covered the tube. These were suspended by light cotton threads, which in turn were fastened to light fuses which connected with the telegraph wires. When the circuit was made, the electric spark ignited the fuse, the fuse burned the thread, and, in a second or so, the board fell before the lens, and the negative was made.

The Royal George had all her sails hoisted except her jibs. She was to be photographed in the highest style of marine art, sailing along over a deep blue sea.

The two kegs of powder were fastened to the schooner's bottom, dropping down about three feet. The water was far too deep (about 35 feet) to anchor them on the bottom. They were put as near the center of the ship's bottom as possible. When all was ready, Gen. Abbot pressed two fingers upon the key. There was a loud booming noise, seemingly under the vessel, and a little smoke. Presently a quantity of water, about twenty feet high, was raised up out of the Sound. Then the Royal George was seen sixty feet in the air, rising high above the smoke and the water, in ten thousand pieces, each piece a mere splinter, a piece of kindling wood, the pieces revolving and striking against each other in the air. Finally there was the descent of the debris, not so rapid as the ascent, the whole mass coming down together with a crash on the water. This caused a little ripple, the smoke died away, the pieces floated along, and everything was calm again.

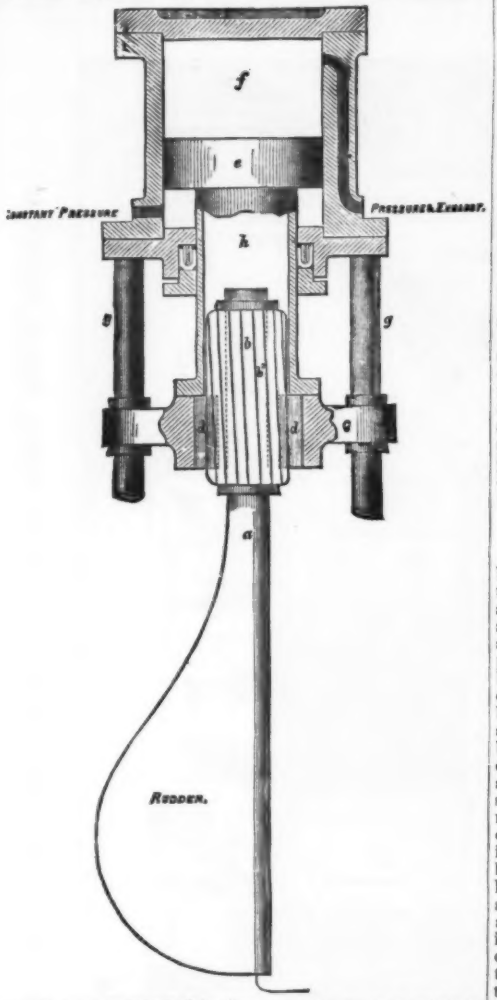
All this time, which was about the time occupied in winking twice, electricity and the sun had been working together, and had photographed the scene. A hundred small boats flew to the scene of the wreck, and hundreds of the small pieces were picked up for relics. It would have puzzled anybody to find a square foot of either sail or masts. Gen. Abbot was fully satisfied with the result, and four excellent negatives were obtained.



RECENT TORPEDO EXPERIMENTS.

HYDRAULIC STEERING GEAR.

THE steering gear of which we give illustrations is exhibited with a sectional model of the stern post of a vessel, in the marine annex of the British department of the Paris Exhibition on the Quai d'Orsai. The importance of efficient steering cannot be too highly estimated, especially for large ships; the employment of manual labor is not sufficiently rapid in its application, and in rough weather may demand a withdrawal of the crew from other occupations which are scarcely secondary, as regards the safety of the vessel, just at a time when they can least be spared; the application of



steam is open to many objections, not the least of which is the repeated failures to which it has given rise—to wit, in the case of the Bacchante, Temeraire, and others. The application of hydraulics appears to offer the most convenient, safe, and simple means of applying sufficient power quickly, and the apparatus we describe, although more or less based on the same principles as the hydraulic steering gear introduced by Sir W. Armstrong, with whom the inventor was formerly connected, is apparently an improvement on any previous effort. The mode of working the apparatus is as follows:

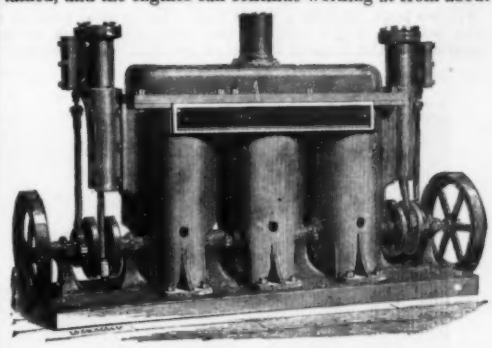
The rudder stock, *a*, has a grooved collar or nut, *b*, securely fastened to it by keys and wrought iron rings at the top and bottom. The grooves in the collar, *b*, are so cut that by the slightest elevation or depression of the slide blocks, *d d*, a circular motion is given to the rudder stock, *a*. The slide blocks, *d d*, are fixed to a crosshead, *e*, worked up or down by the hollow piston rod or trunk, *h*, by the action of water on the piston, *e*, and are compelled to rise and fall in the same rectilinear position by means of the guide bars. The piston with the piston rod or trunk is acted upon by the water thus:

The pipe leading to the under side of the piston marked "constant pressure" is always open to an accumulator, in which a constant pressure is maintained, while the upper side of the piston is put into communication by means of a small valve either with the water under pressure or with the exhaust. As the area of the upper side of the piston is considerably greater than that of the under side, the admission of water under pressure to the top side effects a downward movement of the piston and trunk, while if the pressure be removed from the upper side by opening the communication with the exhaust, the pressure still acting on the lower side will cause an upward movement of the piston and rod, and a contrary motion will be imparted to the rudder. This motion can be regulated to any extent desired, and all jerks of the piston are avoided, the latter being thoroughly counterpoised by the water. By a simple contrivance every movement communicated to the rudder is instantly shown on the bridge by an indicator, which serves also to regulate the water pressure by giving motion to a small crank on the valve spindle and acting as an automatic cut-off valve.

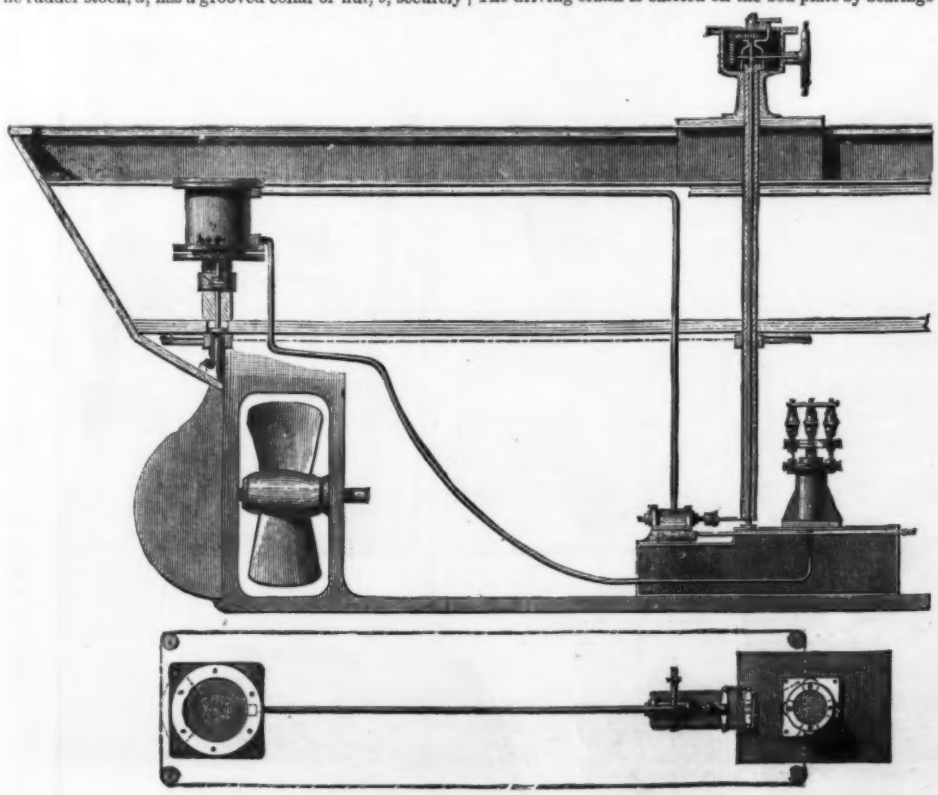
The pumps used for getting up the pressure are of the simplest construction, the one shown in the model being a double-action hand pump, and occupy a very small space, from 2 to 3 square feet, and can be placed in the engine-room and worked from the main boilers. The actual amount of water required by this process is so small that about five gallons will suffice to work a vessel from 1,000 to 5,000 tons. M. Lafargue, the inventor, is in treaty with the French Government for the adoption of this apparatus.—*Engineer.*

IMPROVED BLOWING ENGINE.

FOR purposes of ventilation, blowing machines are now being very extensively employed where underground operations are conducted. For forge and blast purposes also they are much more effective than fans, as these latter must run at a very high speed to force any considerable amount of air, and the percentage of loss increases very largely as the pressure rises. Another great advantage of this form of blowing engine is that as the pressure rises against the blowers, the engine is gradually drawn up, and would be almost brought to a standstill should the blast be shut off. The steam used, too, will be always in proportion to the demand; but in the case of a fan this advantage is not realized, as it continues to churn the air without driving forward at all, and without retarding the speed of the engine in any considerable degree. The system of driving by donkey engine, now very largely adopted, has many advantages. The fan or blower in a smith's shop or blast-furnace has often to run independently, and the means of providing power afforded by the contrivance associated with Messrs. Beverley & Atkins' (Sheffield) improved blowing machine is of such a character as to reduce the cost of maintenance to a very low point, and thus give users an opportunity to effect material saving in manufacture. Very little reflection will make this abundantly clear, for high-speed belting requires frequent attention, and is liable at any time to fail, and cause stoppage of the machine. Two steam cylinders are placed one at each end, thus dividing the torsional strain through the crank. The diameter of the cylinders is 4½ inches, and the stroke is 9 inches. The three blowing cylinders are 18 inches in diameter, with a stoke of 12 inches. The triplicate arrangement is very suitable for uniformly distributing an exceedingly variable strain. The variation between the initial pressure of the atmosphere and the final delivering pressure—even if it be only 3 lbs. or 4 lbs.—becomes very marked when spread over so large an area as 18 inches. Thus the blowing could not be effected with steadiness unless the cylinders were distributed, as shown, around the driving crank. The driving crank is carried on the bed-plate by bearings between each blowing cylinder. The engines drive on to two double disk cranks, with outside bearings, with fly-wheels as shown, which are small, but no doubt sufficient. Each blowing cylinder is a separate duplicate casting, bolted down to the bed-plate, and united at the top by an air-chamber, from which a steady blast is obtained. To this air chamber is fitted an escape or safety valve, so that when the pressure increases by the blast being shut off, a partial relief is obtained, and the engines can continue working at from about



twenty-five to thirty revolutions per minute. The steam cylinders are bolted to brackets cast on the sides of the two outside blowing cylinders. In these single-acting blowing cylinders the valves can be brought very close together, and the clearance between piston and cover can be made very small—the benefits accruing from which peculiarities are most important to all air-blowing or exhausting machinery. In these cylinders the suction valves are carried in the head of the piston, and the delivery valves immediately above them in the covers, so that there can be no considerable loss through clearance. The steam cylinders are of a neat pattern, very strong and self-contained. The whole arrangement is compact and serviceable.—*Iron.*



HYDRAULIC STEERING GEAR.

GEOGRAPHICAL CHANGES MADE BY THE BERLIN TREATY.

THE territorial changes effected by the treaty of Berlin are of a most comprehensive nature. By the treaty of San Stefano, Turkey was called upon to surrender 78,550 square miles, with 4,539,000 inhabitants. The treaty of Berlin deals with 83,300 square miles and 4,882,000 inhabitants, as follows:

	Square Miles.	Inhabitants.	Mohammedans.
Ceded to Roumania.....	5,935	246,000	142,000
Ceded to Servia	4,326	264,000	75,000
Ceded to Montenegro...	1,549	40,000	9,000
Ceded to Austria	15	2,000	——
Ceded to Greece (?) ...	5,300	750,000	40,000
To be occupied and administered by Austria.	28,125	1,061,000	513,000
Formed into the Principality of Bulgaria ...	24,404	1,773,000	681,500
Included in Eastern Roumelia	13,646	746,000	265,000

The island fortress of Ada Kaleh, recently occupied by Austria, is not referred to in the treaty at all, and will probably remain in the hands of the power which now holds it. Roumania, in exchange for the territory ceded, is called upon to surrender 3,270 square miles, with 140,000 inhabitants, to Russia. The political divisions of the Balkan peninsula will henceforth be as follows:

	Square Miles.	Inhabitants.	Mohammedans.
Roumania.....	49,463	5,149,000	143,300
Servia	18,816	1,642,068	75,500
Montenegro...	2,898	210,000	2,000
Turkey.....	140,965	8,359,000	3,081,000

But if we exclude the provinces "indefinitely" to be occupied by Austria, Bulgaria, and Eastern Roumelia, there remain to Turkey only 74,790 square miles, with 4,779,000 inhabitants, of whom 2,521,500 are Mohammedans. In Armenia Russia takes 10,000 square miles, with about 350,000 inhabitants. Cyprus, intrusted to the keeping of England, has an area of 2,288 square miles, and about 150,000 inhabitants.—*Athenæum.*

DR. THOMAS OLDHAM.

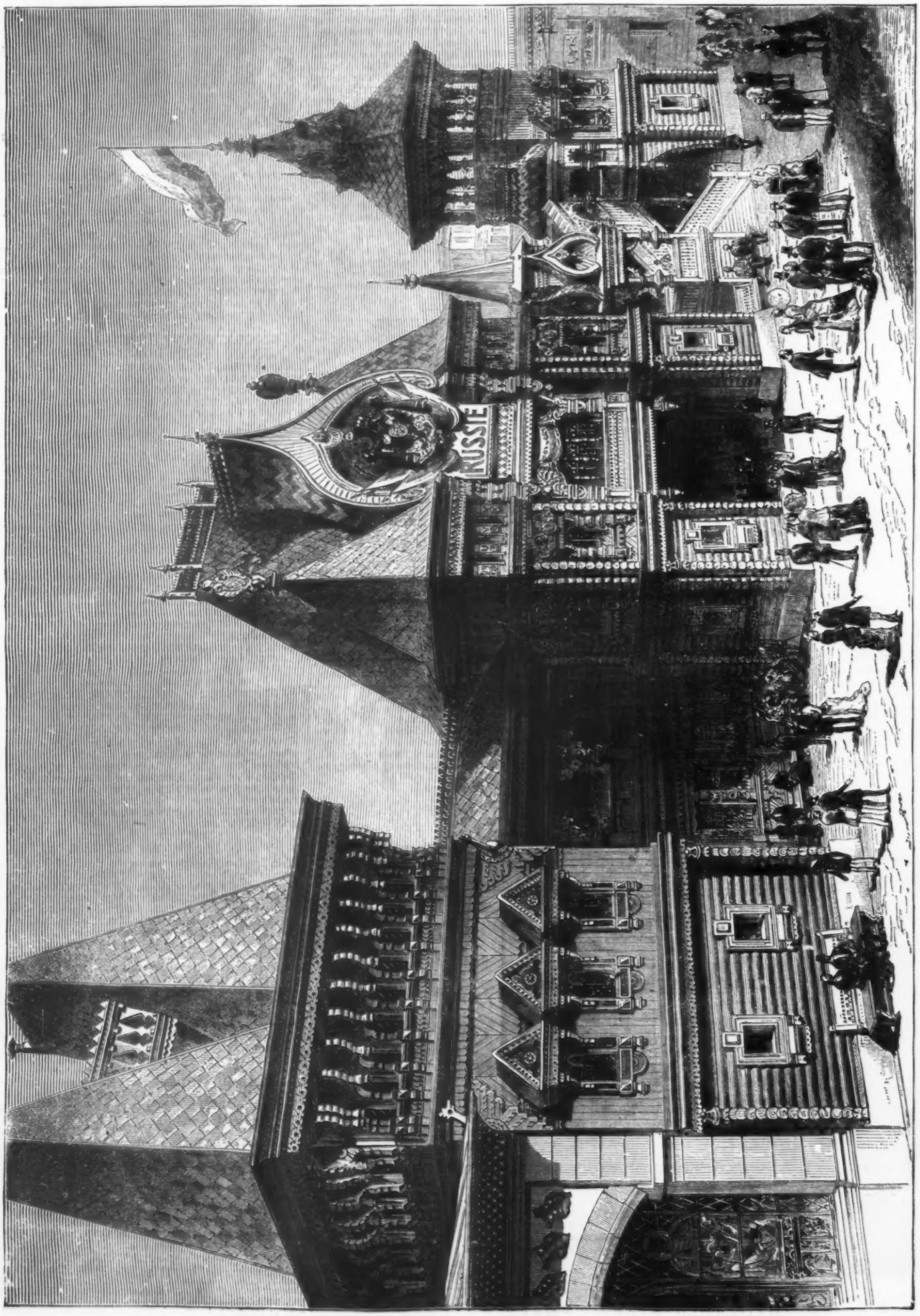
THE London *Times* announces the death of Dr. Oldham, who was from its origination in 1850 till 1876 at the head of the Geological Survey of India. It was under his direction that the official geological survey was commenced, first under the Hon. East India Company, and afterward as part of the government public service, and until his retirement from ill-health he had the control of the issue of the official geological maps, as portion by portion the work was completed, and the issue of the memoirs explanatory of the maps. In 1861, eleven years after the survey was commenced, he originated the publication of the folio-sized "Palæontologia Indica," which consisted of plates, with descriptive letter-press, illustrating the fossils of the country, and the work has progressed steadily in fasciculi as an official publication printed by command of the Governor-General of India.

Dr. Oldham was born in Dublin in May, 1816, and after education at a private school entered at Trinity College, Dublin, at the age of sixteen.

After being for a while curator and assistant secretary of the Geological Society of Dublin, he held for a year the professorship of engineering, and in 1845 succeeded the late Professor John Phillips as Professor of Geology. He was then appointed local director of the geological survey of Ireland, and the Geological Society of Dublin elected him its President. After the various experiences thus gained, in 1850 he was appointed to organize the geological survey of India. There were many unexpected difficulties to contend with, but during the sixteen years of his office these were more or less overcome. While in India he became a member of the Royal Asiatic Society of Bengal, and was four times President. Besides being elected a fellow of the Royal Society in 1848, he received the Royal Medal of the Society in 1875. Dr. Oldham was also a fellow of the Geological Society since 1843, was a member of the Royal Irish Academy, and an honorary LL.D. The Emperor of Austria conferred on him a medal in recognition of his work. The papers he wrote, apart from his official work, were not numerous. Among his palæontological researches and discoveries the "Oldhamia" will be always associated with his name. He died at Rugby July 17.

RUSSIA AT THE EXHIBITION.

THE Russian edifice, which has a very picturesque and interesting appearance, is an imitation, in miniature, of the rural palace of Kolomna, near Moscow, the actual birthplace of Peter the Great. This model of the palace is 130 ft. long, and is constructed of pinewood; the lower part of the front wall, indeed, consists simply of the trunks of pine-trees, stripped of their bark, laid one above another, and kept in their place by mortising with flanges and grooves, and by wooden pegs, without a single nail. The central portion of the building, which contains the wide open porch, giving entrance to the Russian section of the Exhibition, presents a short transverse gallery above the porch, and a second story or attic story, above which rises the steep and lofty roof, in the French style of Louis XIII.'s reign; the main roof is relieved by those of the two side towers, which are pointed and surmounted by fantastic pinnacles of carved and painted wood. The heraldic insignia of Russia are displayed, with accompanying flags, and the name of Russia below on the escutcheon in the center of the summit of this façade. All the windows are small and square, and are set in frames or borders of wood, painted of several bright colors. In the original building at Moscow, at least when it was constructed, above two centuries ago, there would be no glass panes to the windows, but talc or semi-transparent mica. The staircase of this house is outside, in the recess between the central block and that shown to the right hand of our engraving, where the private chapel and the guest rooms of the palace were situated; this staircase is roofed over, and is furnished with massive balustrades decorated with much carving. The nearer wing of the whole range of building shown to the left hand represents that portion which was destined, in the palace of Kolomna, to accommodate the imperial family. Its design, as will be seen, differs somewhat from the other wing of the edifice. The windows of the upper story, belonging to the apartments inhabited by the august owners, are ornamented with triangular pediments, richly carved and painted, which project over the windows. Such was



THE PARIS EXHIBITION.—RUSSIAN MODEL OF THE PALACE IN WHICH PETER THE GREAT WAS BORN, NEAR MOSCOW.

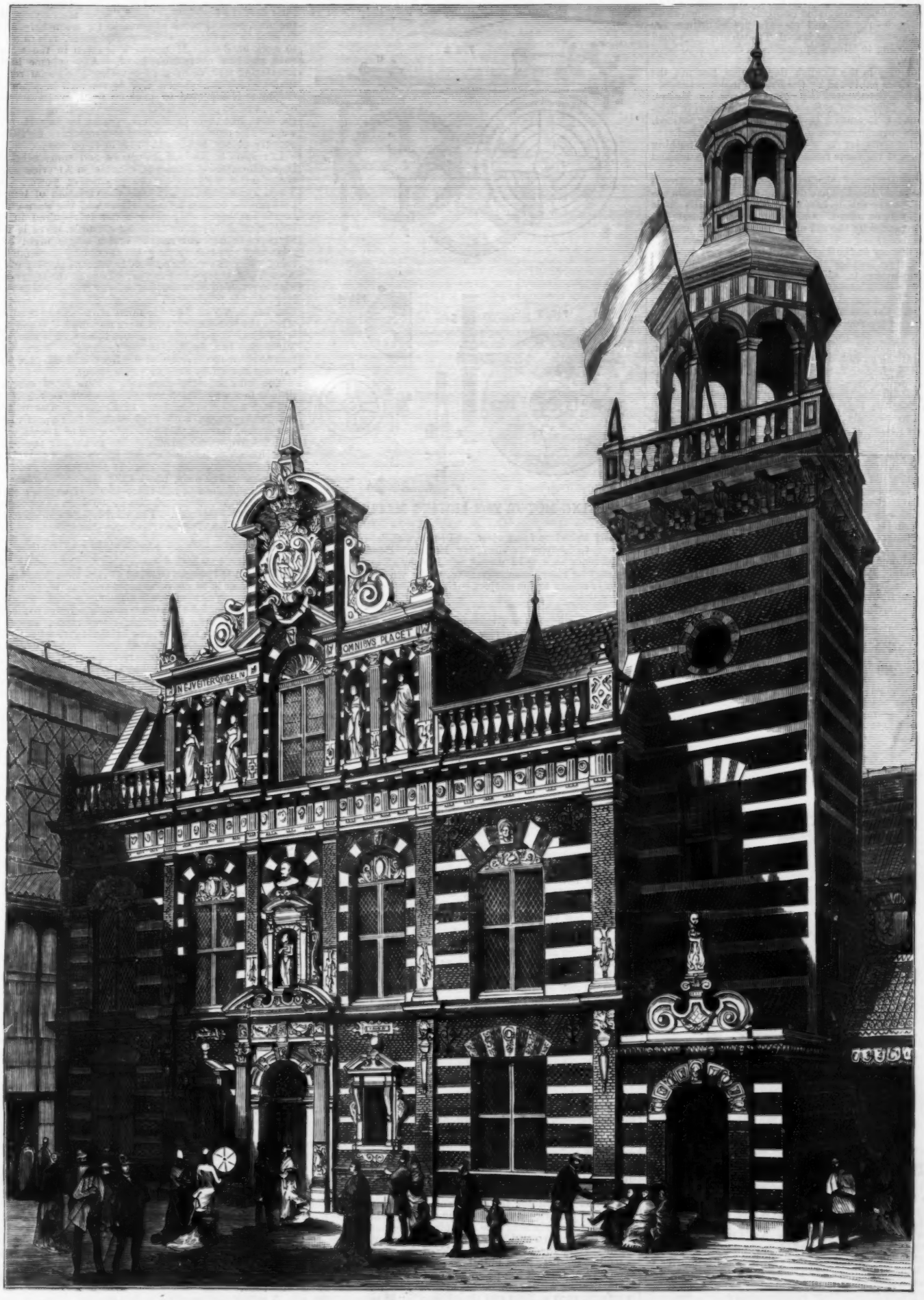
the "isba" or old-fashioned Russian mansion of Prince Alexis Michaelovitch and his wife, Princess Natalia, the parents of the Czar Peter, who was born there in 1673, and whose famous visit to England, with his shipbuilding apprenticeship in Deptford Dockyard, is so familiar to most of us, among the historical anecdotes we learned in our youth. —*Illustrated London News.*

MODEL OF THE TOWN HALL AT THE HAGUE.

THE front building of the Dutch section of the Exhibition, which stands in the "Avenue of Nations," is a miniature copy of the Town Hall at the Hague, an edifice of the Renaissance period and style, dating 1581. The building is of brick, relieved by dressings and bands of white stone. The doorway is adorned with two Grecian pillars, supporting a pediment; above each of the windows is a flat arch composed of brick and stone placed alternately. The principal story is separated from the attic story by a deep cornice, with ornamentation of the Tuscan style, surmounted with balustrades to the right and left, but sustaining in the middle a central upper front, with four allegorical statues of white marble, and with a large window between them. Over all is a shield of sculptured stone, displaying the arms of Holland. The belfry tower, with its open cupola rising from the summit platform, gives an air of dignity to the whole building. —*Illustrated London News.*

BRITISH ARTISAN REPORTERS.

THE Joint Committee of Her Majesty's Commissioners and of the Society of Arts for promoting visits of selected artisan reporters to the Paris Exhibition have now completed the arrangements under which artisans will be sent to Paris. Each artisan is expected to devote from 8 to 14 days to the visit. He will receive £8, out of which he must pay all charges connected with his trip. Free admission to the Exhibition will be granted. Arrangements have been made with the South-Eastern and London, Chatham, and Dover Railway Companies for the purchase of a return ticket to Paris and back, available for 14 days, at the price of 20s. Lodgings have been provided at a reduced scale, and ar-



THE PARIS EXHIBITION.—MODEL OF THE HAGUE TOWN HALL.

rangements have been made for obtaining meals also at reduced charges. Besides the artisans selected by the joint committee, artisans may be sent at the expense of their employers or local committees. Such artisans will be supplied with the necessary cards and certificates to enable them to take advantage of arrangements and facilities afforded by the joint committee. Employers or local committees subscribing to the fund may select or send out artisans, in number to the extent of one for each £10 subscribed, or subscribers to the fund may nominate for consideration and selection by the joint committee such artisans as they may think suitable to represent the special trade or trades of the district or party subscribing.

COLORS AT THE EXHIBITION.

Reimann's Färber Zeitung notices the colors and dyed and printed textile goods on view at the Paris Exhibition. Joly's process for carbonizing vegetable impurities in woolen cloth is to be seen in its results, and appears not to injure the more delicate colors. The shades of Tussah silk, bleached and dyed according to Girard's process, are declared to be of finished beauty.

A similar display in the English department has not the finish of the colors exhibited by the French manufacturers.

In the English department the colors shown by Messrs. G. Lowe, L. J. Levinstein & Sons, Brooke, Simpson & Spiller, and Williams, Thomas & Dower are particularly noticed. The absence of any specimens of dyed furs is remarked.

The American display is pronounced to offer nothing worth notice, and the same remark is applied to Sweden and Norway.

A Spanish collection of shaded woolen yarns far exceeds anything similar in the French department. Australia exhibits but little, though in fine woolen yarns it falls little short of the Berlin standard. Calico printing in Russia has made great advances by the aid of foreign skill and protective duties.

The Swiss display in the Paris Exhibition is very interesting. J. R. Geigy, besides the ordinary aniline color, exhibits diphenylamin in shining scales, methyl-blue and resorcin in crystals of the average size of soda crystals. The second side of his showcase contains ground dye woods, extracts, and indigo substitute; the third, hæmatoxylin, eosin, cyanin, etc.; and the fourth, dyed silks. P. Monnet & Co., of La Plaine, near Geneva, excel in the blue shades of eosin (phloxin and cyanosin). They exhibit also aniline scarlet, and a model of the autoclave for the production of methyl-chloride. Bindschedler & Busch, of Bâle, exhibit the products of the alizarin manufacture, such as sublimed alizarin, anthracen and anthraquinon sublimed in splendid yellow crystals an inch in length; also eosin, methyl-eosin, and methyl-green in crystals of a coppery luster. Freund & Merlanchon, of Bâle, exhibit phthalic acid in crystals eight inches long, resorcin in large crystals, fluorescein, eosin, both free and as a sodium salt (soluble in water), naphthylamin, Magdala red, nitronaphthalin, azo-dinaphthylamin, etc. Durand & Huguenin exhibit large crystals of phthalic acid, resorcin, and fluorescein, as also gallein and cœrulein, the recently discovered phthaleins of pyrogallic acid. Gerber & Uhlmann exhibit large blocks of diphenylamin and the blues produced from it; also benzyl yellow, aniline gray, etc. Great praise is awarded to the Swiss silks.

In concluding, the editor remarks that the French are fully aware of the superiority of the Germans in dyeing, especially in woolen goods. The general character of the Exhibition is a want of novelty. The electric light is strongly recommended for use in dye works, as it permits colors to be compared as accurately as can be done by daylight.—*Chemical News.*

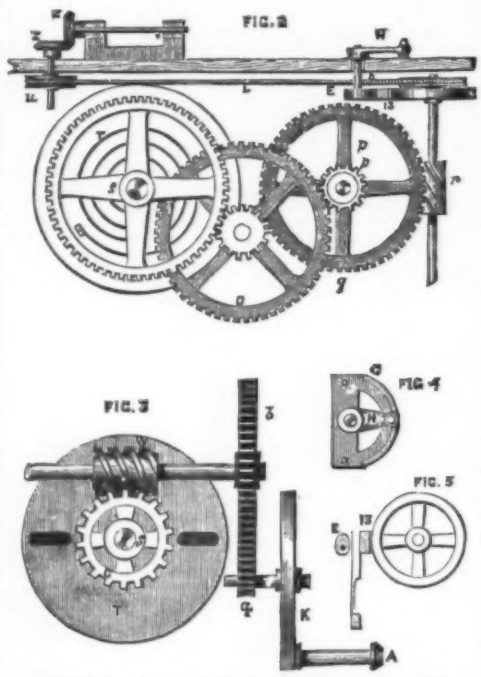
SEWING MACHINE SPRING MOTORS.

In the Austrian department of the Paris Exhibition are several illustrations of the application of the spring motor by Messrs. Schreiber, Salomon & Co., of Vienna, to sewing machines. The machine, as will be seen from Fig. 1, applied to a sewing machine, takes up very little space, and from Fig. 2 is constructed as follows:

S is a spindle to which two spiral springs, each twelve meters long, are attached side by side in the case, T, which revolves on the spindle, S, and to which the springs are fastened at their other end. The case containing the spring is

FIG. 1.—SPRING MOTOR FOR SEWING MACHINES.

wound up by the handle, A, fixed to the crank wheel, K, which by means of the cogged gear, *a* and *b*, transmits the motion to the worm screw, W, and through it to the cogged wheel, C, which actuates the spring case. The machine requires about three minutes to wind up, and with a speed of about 5 so stitches per minute will run for over a quarter of an hour. Without going into all the elaborate calculations of Professor Radinger as to the time required to wind it up, and the length of time during which a seam may be finished, and the difference between the power required and the effect produced, we can safely say, from seeing it at work, that it presents none of the usual objections generally attached to spring machines. Apparently there is no danger from a breakage of the spring, its action can be easily controlled, and there are few parts to get out of order, and from the way in which it is protected there is little fear of their getting dirty and clogged. Nevertheless there is the old objection to depending on a metal in tension when the work demanded of it is extreme and intermittent. The mechanism of a clock is adduced as an argument in its favor, but the conditions are totally different, and unless the tension of the spring be allowed to run out after every operation of winding up, we hardly think much reliance can be placed on its endurance; and the fact of its remaining at rest for long and sometimes unequal intervals necessitates considerably more caution in again setting it in motion than it is likely to receive from the hands into which it is intended to fall. There are one or two somewhat similar but more expensive machines in the French department, of which the inventors either think so much, or so little, that they keep them re-



SPRING MOTOR FOR SEWING MACHINES.

ligiously boxed up from view, and reserve their explanation of them to holders of the Jury Button. Possibly, under the influence of a gold medal, which they all expect to get, they may be more communicative, when we shall take occasion to return to the subject.—*Engineer.*

[Continued from SUPPLEMENT No. 139, page 2207.]

ENGLISH INDUSTRIES AND AMERICAN COMPETITION.

II.

ORDER AND SYSTEM OF AMERICAN WORKSHOPS.

AMERICANS like to show their workshops and factories because for the most part they are fit to be seen. The order, system, and cleanliness of such places, especially in New England, must be seen in order to be believed, and as such order and system has much to do with the product of works of any kind, it is a proper subject to be noticed here. The use of anthracite smokeless coal throughout all the country east of the Alleghany range of mountains permits a cleanliness which would be impossible if bituminous coal was burned. In Philadelphia, for example, where factories are to be found in all parts of the city, the air is nearly always as clear as it is at sea. The only bituminous coal used is for smithwork or gas-making, and in some parts of the city it would become an actionable nuisance to burn bituminous or smoking coal. In New England the fuel employed for steam both in factories and for steamers is anthracite, and nothing is known of that dingy black which in the Western States, as with us, makes everything seem dirty and untidy. We venture the opinion that the influence of system and order arising out of possible cleanliness has much to do with the success in America of those industries where minute pieces are dealt with, such as clocks, watches, sewing machines, and the varied kinds of hardware which is polished, japanned, or otherwise ornamented. As one goes westward and enters the bituminous district, manufactures become coarser and the system less, dirt and disorder culminating perhaps in Pittsburg, where there is a strong analogy to our own Black Country district, not only in the aspect of things, but also in the type of products. Shovels, hoes, chains, bolts, nuts, rivets, and so on, what may be called the cruder products of metal, as well as from other kinds of material, are made in the black cities of America.

We have also in Europe some evidence of the effects of soot and grime on the industrial traits of people. Taking two countries, one in the south and the other in the north of Europe—Switzerland and Sweden—we may see the tendency to minute and exact manufactures. There is in America a saying, and not without truth, that "an Englishman disdains to work at a piece which he cannot strike with a four-pound hammer," and there is some truth in this, not directly due however to the influence of smoke and dirt, but to traits produced by several causes.

Another reason for the order and neatness of American shops and factories is found in the climate, which, throughout nearly the whole of the manufacturing districts, that is to say the Eastern and Middle States, renders artificial warming necessary for at least one-half of the year. Artificial warming requires good buildings and a close attention to the economy of fuel; it has personal comfort for its object, and while dealing with temperature, attention is directed to other comforts, such as light and cleanliness. "It pays to have a warm and comfortable place for men to work," is a remark one often hears in America. The best shops and factories have the best workmen, and as a general rule the character of a building and its comforts are reflected in the work done within its walls.

In this country and on the Continent as well, there has of late years been much done in the way of providing comforts and conveniences for workmen, but these efforts, while seemingly the same as we are speaking of in America, are nevertheless different. In some of the works are dining halls for the workmen, also libraries and other things provided, which show a benevolent spirit, and no doubt in many cases an unselfish regard for the interests or comforts of workmen, but such things do not answer well in America. They partake of the "patriarchal idea," and a workman prefers to attend to his own eating, education and amusements. His eating is done at home with his family. No workman would think of going to the works before breakfast and improvising one himself after working an hour or two. This is his wife's business, and she with the rest of the family expect to eat their breakfast with the "head," who, after laying plans for the day, goes to work at seven in the morning. At twelve he goes to his dinner, at home if possible, returning at one to work until six. If luncheon is eaten in the works it is cold, and beer never thought of. Any scheme looking to interfering with or even recognizing the social regulations under which skilled men live is resented in America. An employer is expected to provide light, warming, water to drink, and to pay for what is done; anything more wanted, the men, like their employers, prefer to buy in their own way. The patriarchal method is sometimes carried out in country places, but not in cities or large towns.

In respect to the iron industries and some others of less importance, the extremes of climate in America exercise a considerable influence on the productive power. In New York, Pennsylvania, and Ohio the variation of temperature between the coldest days in winter and the warmest in summer is 100 degs. Wherever water is required in exposed buildings, as in rolling mills for example, there is no safety for pipes or inclosed vessels, and a single night of severe frost may cause damages great enough to consume the profits of a month's business. At Bordentown, fifty miles from New York, there was last year a flood in the Delaware River high enough to overflow the railway shops at that place. A large double-head wheel lathe was constructed with hollow box heads, which became filled with water from the top where the spindle bearings were mounted. When the flood went down these heads remained filled with water, and were burst open in a single night by freezing. We mention this fact to show the severity of the frost, and the care as well as expense caused by such severe weather.

The iron industry generally suffers from climatic conditions in a way that must always leave, as the Americans call it, "a margin" in favor of England. Comparing Eastern Pennsylvania with Staffordshire in respect to climatic conditions, there should be a difference of a tenth or more in the effective working time. Two months of the summer in America are so hot that even if men manage to work around furnaces the enervating effect is such as to greatly impair their physical powers, besides the exposure increases wages by reason of the risk and discomfort. Imagine a puddler at work with the air around him at 100 degs. or more, drinking ice water to keep cool. The vital organs chilled to counteract external heat!

OPPOSITION TO LABOR-SAVING INVENTIONS.

The spirit in which labor-saving appliances are received in America is brought to mind at this time by a deplorable circumstance of recent occurrence in Manchester, a thoroughly progressive city, where a firm engaged in manufacturing bricks had decided to employ some machines to facilitate or cheapen the work. An attempt was made, supposedly by the workmen, to murder one of the firm, with his family, by throwing into the house what is sometimes called an "infernal machine," a bomb charged with powder and slugs and a burning fuse attached. The bomb was thrown against the fanlight, but fortunately did not break through, but fell outside, where it exploded without doing harm. Two days later a similar attempt and for like reasons was made to murder a family in Cornwall, when a house was shattered, but no lives lost.

We can well afford to balance such horrid outrages against the stories of American rowdyism, and to admit their deplorable nature, but at the same time it becomes our duty to look closely into the causes which have in America very nearly destroyed such opposition to labor-saving inventions.

It is not easy to determine how far the different circumstances of the two countries in respect to population, markets, and so on, may have to do with this opposition to labor-saving appliances, or how far it is due to moral and social conditions with which we do not want to deal further than is necessary, yet we may notice what seems to be the popular idea among workmen in America of the effect upon their interests of labor-saving machines.

There are two arguments which will be met with whenever the subject is talked of. One, and the main one, is that, notwithstanding all speculations and opinions on the subject, it is a certain fact that the actual effect of labor-saving machines is to increase wages and improve the condition of workingmen. Around on every side the proofs are existing. The changes have been made within the limit of one person's observation, and all the sophistry which can be brought to bear will not weigh much in the minds of so practical a people when facts are before them.

The consumption of manufactured products, by reason of their cheaper price and consequent wider range of adaptation, and also the accretion of new articles of manufacture, more than balance all labor-saving effected by machinery in America. The people well know this, not as a speculative opinion, but as a settled conviction, and in this fact alone rests one of the powers of improving industrial production.

The other argument alluded to is of a still more practical nature, and better understood, namely, "that it is folly to oppose what is inevitable." The forces, if they may be so called, which oppose machine improvement, are weaker in America than here; but the certainty of the final adoption of whatever improves or cheapens products is no greater. The most that can be hoped for is delay, and in this fact no doubt rests a considerable part of the difference in views between workmen here and in America, granting that in both cases they were opposed to labor-saving machines. Delay in America would at most mean months, while here and in some other European countries the same delay might be measured by years.

To illustrate the pernicious effects of this fanatical and illogical war upon invention, we will give a brief narrative of the general facts in a case having special interest at this time.

A patent was granted in this country in the year 1854 to Messrs. Slater & Tall for improvements in machinery for making hand planes such as joiners and other wood work-

men employ. This machinery, we have been told, was erected in London with every promise of success, but the danger was so great from the opposition of plane makers that the plant was removed to another part of the country, where the invention finally succumbed to mob rule.

In respect to these later facts we have no positive information, but in respect to a future appearance and application of these same improvements in America we have more complete data. In the first place we may explain that this patent of Messrs. Slater & Tall is a very remarkable one, embodying perhaps more that is original, and at the same time practical, than any patent, one excepted, which has ever been granted in this country for wood-cutting machines, and strange to say it comprehends nearly all the principles existing in machinery now employed in America for cutting out the throats of and otherwise shaping hand planes.

Plane manufacturing is a prominent branch among the industries carried on in two penitentiaries in America, one at Auburn in the State of New York, and the other at Columbus in the State of Ohio. The convicts, who are hired by contractors from the States, perform all the work, even the most skilled parts.

About the year 1866, these inventions of Slater & Tall's, without much modification, reappeared in one of the penitentiaries, it is said through information furnished by a convict who had worked in the London factory, and in time one of the principal machines, employed for cutting wedge grooves, was adopted in the other prison and also in another large factory. These machines, supplemented of course by various auxiliary inventions and the improvements naturally arising from practical experiment, are now at work in producing planes to compete with our own in the colonies and various markets formerly supplied from here, and we might add there is little hope of competing in the race.

The white beech wood employed for plane stocks is better and less expensive in America than here, and the processes of making plane irons are at this time no doubt as complete, but still the main factor in determining the expense of producing planes and securing a market is the cost of fitting, or making up, and the quality of the work when done. With the machines before named a man can finish four times as many common planes as could be done without the machines, or taking all the labor of a plane factory together, except making the irons, the effect of employing machines may be safely estimated as doubling the production. It may be added that the throat machines now employed in America so much resemble the drawings in Slater & Tall's patent that one might be mistaken for the other, that is, the machines seem to have been made from the patent drawings.

This case is no doubt an exceptional one, because improvements in wood cutting, for twenty years past at least, have come mainly from America; but previous to that time, strange to say, the records of the British Patent Office show many great and important improvements in this branch of industry which never came into practical use; no doubt because of the unreasonable opposition of workmen and the danger of violence which attended on every attempt to economize labor.

In this connection we will further remark in respect to wood-cutting machines that, measured by a fair standard, the obsolete designs to be found in the patent records of machines of this class are in many respects better than common modern practice. There is nothing in these old patents like the ponderous, unwieldy, and we might add inefficient machines now employed upon railway wagon work, for example. For strains to be counted in hundreds of pounds we have in most modern machines framing and other proportions suited to as many thousands of pounds, and the principal points of endurance in the machines are required to meet strains and shocks independent of the cutting action. We have lost much by the long period wherein mob opposition, among other lesser causes, has hindered the art of wood cutting in this country, because if these old designs had gone more into use, present experience would be more advanced, and machines would now be in adaptation what they are in general design and good fitting.

To return to the absence of such opposition to labor-saving machines in America, there is one reason at the bottom which will not apply to most European countries, that is the ease and frequency of transition from the position of an employé to that of an employer. Perhaps it may be said that every good workman in America is looking forward to a time when he will himself employ labor either as an independent master or as a contractor on piece work. In either case his interest in labor-saving appliances will be much the same, and the fact is, be the cause what it will, that to this time American industry has suffered very little from opposition to machine improvement.—*Engineering.*

PATENT FUEL IN THE FRENCH NAVY.

As the subject of French coal is now exciting some attention, consequent on the great strike in the most considerable of the French coal fields—that situated at Anzin and neighborhood—it may be interesting to the colliery proprietors of South Wales if we gave a translation of a memorandum furnished by the French Government on the advantages of using patent fuel in the French Navy in preference to steam coal. The memorandum was obtained from the French Naval Department by Capt. Howard, naval attaché to the British Embassy at Paris, who remarks that patent fuel has been adopted in the French Navy for some time, and but little plain coal being now used there is not much opportunity of drawing a comparison. Baron Roussin, head of the establishment of the Minister of Marine, says that French coal only is used in the manufacture of Government patent fuel in order to encourage native industry, and that the best coal is obtained in the North of France, notably from Anzin. The following is a translation of a portion of the memorandum referred to: "The French Navy has been led to adopt the use of patent fuel on board the vessels of the fleet, because that kind of manufactured combustible has the advantage over ordinary coal of doing away with, or at any rate sensibly diminishing by its artificial cohesion, the considerable loss occasioned by the brittleness which characterizes most of the coals in their natural state. At the same time its regular shape lends itself more readily to the conditions of stowage and keeping so essential to ship's fuel. Patent fuel is, as a rule, composed of coal dust obtained from the rubbish of the coal taken from the mine and of 8 per cent. of tar (combustible matter), and comparative experiments with patent fuel and lump coal of the same kind have invariably demonstrated that the results furnished by combustion under the same conditions have been the same in both cases, as much in regard to the heat giving properties each possessed as in the quantity of steam, etc., produced. The residue of cinder is the same in both cases. And as it is always possible to reduce the quantity of ash in the dust coal to a lower minimum than the quantity of ash can be produced in the lump coal, and likewise in the same way to reduce the caking of the clinkers on the fire bars, and so lessen the work of the stoker, patent fuel is preferable to lump coal. Besides, patent fuel can be mixed in the most advantageous manner, just in the same way as lump coal; and as in England it has been found of great advantage to burn the best heat producing and slow burning coals of Cardiff with the light but fiercer burning Newcastle coals, so the French Navy requires that the greatest heat producing but slow burning patent fuels of the same kind as Cardiff coal, and the quick and fierce burning ones like Newcastle coal, shall be burnt together, mixed in the proportions which have been found most suitable for the general purposes of their use on board ships, or directs that the patent fuels be burnt separately, as circumstances require, in the colonies—for instance, where the draught is slight. The ordinary proportions of the mixture are one-third of rapid burning patent fuel to two-thirds of slow burning patent fuel. The French Navy takes care to stipulate in its bargains for a maximum of the quantity of ashes in the patent fuel. The maximum varies in the French coals from 7 to 10 per cent., according as the coals are more or less earthy or rocky, and as their coal dust can be made into patent fuel in a dry or wet state. The patent fuels of South Wales are generally obtained at 7 per cent. without previous washing."

The memorandum goes on to consider the quality of the tar used in the manufacture of patent fuel, the degree of cohesion, and the size of block to be preferred. The tar is placed in a closed testing furnace, and the results of good tar are stated to be 1 to 2 per cent. of cinders, 45 per cent. of coke, and 55 per cent. of volatile products. If the tar is too thin, or, in other words, has an excess of liquid, the greater quantity of volatile products evolved during the combustion will have a tendency to injure the eyes of the stokers; while if the tar be too thick the degree of cohesion is lessened, and the patent fuel more liable to breakage from being handled, and by the influence of the air during the time it is kept stored. The degree of cohesion is ascertained by placing the fuel, broken into pieces of about a pound in weight, in a cylinder formed of iron bars, which is then subjected to 50 revolutions, at a speed of 25 revolutions per minute; if the dust which falls out through the bars is not more than two-fifths of the quantity experimented on, the fuel is considered to be of good quality. With regard to size, the French Government consider that blocks of 9 kilos., or about 19¾ lbs. in weight, are the most advantageous, being preferable to blocks of smaller size, by reason of the facility of loading, and less liability to breakage at the angles.—*South Wales Daily News.*

LAMPBLACK GUNPOWDER.

ACCORDING to an invention made by M. Raymond Cahuc, of Toulouse, in 100 parts of the powder he takes 48 to 70 parts of nitrate of potash, or other equivalent salt, the quantity being regulated according to the strength of powder required; eight to sixteen parts of sulphur, according to the quality and the rapidity of explosive power desired in the powder; three to five parts of lampblack or soot—soot from wood is preferable to that from coal, and lampblack is preferable to soot; the quantity is regulated according to the strength and rapidity of explosion required. The remainder of the 100 parts is made up of spent tan (if containing refuse animal matter preferred), or sawdust, or the two combined in any proportions. The spent tan is preferred, but whichever is used it should be well dried before being employed. The above ingredients are finely ground, and then mixed together in a boiler, and moistened to a consistency of a stiff paste with water in which has been previously dissolved sulphate of iron to the extent of from 1 to 5 per cent. by weight of the other ingredients or substances, the quantity being regulated according to the purity of the soot or lampblack and the tan or sawdust, the smaller quantity only being necessary with purity of the other ingredients. The mixture is then subjected to a heat of from 120° to 130° (Rem.), under which the whole first liquefies and afterward solidifies. While subjected to this heat the mass should be constantly stirred with a wooden instrument, especially while settling, otherwise the whole may harden into a lump, but if stirred will become powder. On this stage being reached the compound is removed from the fire, and subjected to a lower heat sufficient to dry it—say about 50° (Rem.). The compound is then ready for use, and may be stored and carried with the utmost safety, as it will not explode unless confined and compressed.

To obtain the full results and benefits of the powder it should be well compressed before being exploded. It may be exploded by the means usually employed for firing ordinary blasting powder. The boiler in which the mixture is heated should be much larger than necessary to hold the ingredients while cool, as on being subjected to the heat the mixture increases greatly in bulk. In practice he has found the following proportions of the before mentioned ingredients produce the best powder for the respective purposes named: For the blasting of hard material offering great resistance he uses of saltpeter, 70 parts; sulphur, 12 parts; lampblack, 5 parts; tan or sawdust (well dried), 13 parts; and sulphate of iron, 2 parts. For substances offering less resistance and for coal getting he uses of saltpeter, 64 parts; sulphur, 13 parts; lampblack, 4 parts; spent tan or sawdust, 19 parts; and sulphate of iron, 3 parts. For bituminous coal and gypsum quarries, and such like materials, he uses of saltpeter, 56 parts; sulphur, 14 parts; lampblack, 3 parts; tan or sawdust, 27 parts; and sulphate of iron, 5 parts. For many purposes the compound may be profitably employed combined with nitroglycerine, kerosene, or other similar explosive oils or substances, or, as for example, for torpedoes and stone quarrying, and works under water. The combined product is not inexplosive, as is his product alone, but the mixture is only made at the moment when it is to be used, thus reducing the danger to a minimum. A good proportion for a good serviceable compound is about 15 to 25 per cent. of nitroglycerine or the other explosive employed, the remainder being his improved powder, but of course the proportions must necessarily vary according to the strength of explosion required. The mixture may be effected either in the borehole or previously in a wooden vessel. The tamping must be carefully effected in the usual manner.

CARBONIZATION OF WOOL.

CONSIDERING the constant complaints of unclean wool, it is surprising that carbonization is not more resorted to. Every manufacturer knows the disadvantages connected with wool containing seeds, burrs, and food of all kinds; how these injure the cards, as they cannot well be taken out completely by the willy or openers; how they occasion breakages in the mule, and thus cause much delay and loss. The same disadvantages are felt in the weaving department; the ends break more frequently, the loom must run slower, and the weft cannot well be beaten up—in fact, all good qualities of the cloth, closeness, evenness, strength, and staple, are injuriously affected. Even when woven the cloth made of such unclean wool is not perfect, and has to be submitted to the ordeal of the nippers to make it salable. We believe we are not wrong in stating that the French manufacturers, who also use colonial wool, are more careful in this respect than many of our own, and that they clean their wool more by the carbonizing process, for which in some places special establishments are in existence. Where the wool is very impure this is done before the carding. But there are certain kinds of wool which can be easily freed from the bulk of these impurities, while it is more difficult to remove the smaller particles, though they are perceptible in the cloth; in that case it is customary to carbonize the cloth instead of the wool, which is done before the milling and after the cloth has been washed. Some manufacturers dye specially in order to hide these impurities; but however much they may be dyed they cannot be concealed from the touch, for the pyrolignite of iron which is used for that purpose is injurious to fine wools, giving the cloth a harsh and disagreeable feeling.

If carbonization is not more widely adopted it may be through prejudice or ignorance of its value, and the belief that it would injure the strength of the wool, which it is asserted it does not. Any one who is conversant with the process will agree that the strength of the wool is not in the least impaired by carbonization, while trials have proved that the wool thus treated has actually gained in tensile strength and elasticity, and the cloth made from it has a softer and more agreeable feel. Carbonization thus, instead of damaging the wool, actually is of special advantage to it, and if any parties interested in the subject have any doubt about it, the *Deutsche Wollengewerbe* will, it says, be glad to lay the proofs before them.

ARTIFICIAL PURPURINE IN DYEING AND PRINTING.

By M. A. DUPUY.

IN 1874 M. F. de Lalande effected the synthesis of purpurine by fixing upon alizarine a fifth atom of oxygen by means of a process of oxidation entirely new for compounds of this class.

The industrial success of artificial alizarine, the ideas put forward long ago by M. Camille Kœcklin, and taken up again lately by M. Rosenstiehl (*Bulletin de la Société Chimique de Paris*), on the constitution of madder reds and roses, foretold a brilliant future for this new artificial coloring matter, necessary to obtain the true madder red or rose. We might expect to see appear in the market either purpurine almost pure, which might be mixed in required proportions with alizarine to produce a madder red, or alizarine alone, partially transformed into purpurine in the proportions of the extracts of madder. These extracts, already threatened by the rapid success of alizarine, would, without doubt, completely disappear on the appearance of artificial purpurine, and the cultivation of madder would be abandoned at no distant date.

At present this is not the case, and the madder trade, like that in extracts, is still alive. It would be evidently hazardous to foretell their condition in a remote future, and that is not the question which occupies us at present. We are simply concerned to know what are the circumstances and the obstacles which have hitherto rendered the synthesis of purpurine inapplicable.

The attempts made to obtain purpurine by fixing upon alizarine a fifth atom of oxygen, by the substitution of a third hydroxyl group for an atom of hydrogen, have failed. On carefully heating sulphalizaric acid with caustic potash, and precipitating with an acid, we merely obtain traces of alizarine. There has been already opportunity to observe the oxidizing action of sulphuric acid in the preparation of bisulphanthraquinonic acid by heating the bibromide or bichloride of anthracene along with sulphuric acid. M. de Lalande obtains purpurine by heating alizarine dissolved in sulphuric acid, in presence of an oxidizing agent like peroxide of manganese or arsenic acid, at the temperature of 264° to 302° Fahr.

It must be remarked that sulphuric acid alone is able to transform alizarine into purpurine without the aid of any other oxidizer, and that arsenic acid and oxide of manganese merely serve to facilitate the reaction and effect it at a lower temperature.

If one part of dry alizarine is heated with ten or fifteen parts of pure concentrated sulphuric acid to between 392° and 428° Fahr., there takes place at about 346° a regular escape of sulphurous acid, which becomes an effervescence if the temperature indicated is exceeded, in which latter case the mass becomes carbonized. It is therefore needful to watch the temperature with care if we wish to obtain a result. At the end of some time a drop of the sulphuric liquid thrown into a solution of alum shows fluorescence, the intensity of which indicates when to stop the operation, which lasts from ten to fifteen hours.

This process is not available. It must be added, however, that at this temperature soluble compounds are formed in quantity, and are precipitated in brown flocks from the washing waters when neutralized. The yield of the operation on a laboratory scale amounts to 75 per cent. of coloring matters dyeing like the purpuric extracts.

By the arsenic acid process the process is exceedingly simple; the heat is only from 266° to 302° Fahr., and for a much shorter time.

According to intelligence received from the author of the synthetic process, "in laboratory operations there is obtained a yield of purpurine containing, however, traces of alizarine of 101 parts for every 100 parts of alizarine employed. In different manufacturing trials on the large scale, from 22 to 33 lbs. of dry, impure alizarine being used each time, the mean yield was 90 per cent., and could doubtless be easily exceeded when the practical part has been more thoroughly studied."

Crude purpurine, when washed, is in the form of a brown precipitate, which gives in dyeing the shades of the purpuric madder extracts, as bright, and as much on the yellow side of red. In printing, on the contrary, nothing is obtained but a reddish-brown, which is easily degraded by soap.

As M. de Lalande asserts: "If the alizarine employed contains even a few hundredths of isopurpurine, the purpurine prepared from it is useless in printing. The brown product of the transformation of isopurpurine is fixed in steaming, and hinders the fixation of the purpurine; in dyeing the brown matter remains in the beck, and the purpurine alone dyes the mordanted tissues. With very pure alizarine we can obtain purpurine equal to Pernod's extract, but it would be difficult to obtain regularly a product of suffi-

cient purity. Very pure alizarine is, moreover, much higher in price than alizarine at 90 or 95 per cent., so that it would be cheaper to buy the latter and to purify the crude product."

The only means of purification known at present is with alum. The crude purpurine is dissolved at a boil in solution of alum or of sulphate of alumina at 6° Baumé. It is let cool if there is still alizarine to be separated, filtered, and the pure purpurine is precipitated in orange-red flocks by the addition of sulphuric acid. In this state it prints a fine scarlet-red, rivaling the most beautiful application-reds got with purpuric madder extracts.

Consequently, admitting the purification with alum and making use of impure alizarine, at the present price of this product and of the purpuric extracts it would be possible to manufacture purpurine to advantage. The obstacle which has been in the way of this manufacture has been the production of isopurpurine at a lower price than alizarine, the raw material of purpurine. It was therefore impossible to compete with isopurpurine, which, on account of certain of its properties, is preferable for dyeing to purpurine.

With the new oily compounds isopurpurine gives, in dyeing, reds perhaps more beautiful than those of purpurine, and, above all, better able to resist oxidizing agents and chlorine. Of two oiled swatches dyed, the one in purpurine and the other in isopurpurine, brightened in the same manner and soaked in a solution of chloride of lime, the former is rapidly decolorized, leaving merely a pale rose, while the second resists, and is merely browned. The action of alkaline red prussiate, devised by M. Wagner, shows also perfectly the slight resistance of purpurine against oxidizing agents.

In application colors the case is changed. Isopurpurine reds in some instances have had less success; they have been accused of being of a brick-red and of turning brown on chloring. These observations must be founded if we consider that the extracts of madder which are free from these inconveniences are still in constant use.

The elevated price of the purpuric extract, which has been kept up for such a long time in spite of the great reduction in the price of isopurpurine, proves that the former product has an undeniable industrial importance.

Admitting the purification of alum, it is possible to obtain a product quite as beautiful as the most select purpuric extract; but this extract at 9 per cent. costs at present 11s. 8d. for 35 ozs. Impure alizarine at 10 per cent., the raw material of purpurine is worth from 5s. to 5s. 10d. These figures are sufficiently conclusive.

There is still a fact to point out. In the purification with alum, after filtration, the residue dyes roses of a remarkable purity, which are far from equaling the roses of the original alizarine. The application roses of commercial alizarine do not touch the brightness of the roses of certain extracts of madder, and mixtures of artificial alizarine and purpurine give roses of a more yellow cast, which still want the carmine tone so much desired.

It seems that after the facts cited above it must be traces of isopurpurine which deprive the application-roses of artificial alizarine of their brightness.

If the oxidation is not pushed too far we might, by a preliminary exhaustion with alum-water, separate the larger part of the purpurine. The residue might be re-treated with boiling alum water, and filtered at a boil, and thus we might separate the brown products of transformation of isopurpurine, and collect the alizarine, which on cooling precipitates from the filtrate.

The use of artificial purpurine will be in printing; in dyeing it must yield to its isomer isopurpurine.—*Teinturier Pratique.*

MARBLE SEPULCHRAL MONUMENTS IN GENOA.

Sarcophagus Fig. 1, the work of Montorsoli, a pupil of Michael Angelo, is erected in the Church S. Matteo, the burial place of the Doria family. The monument, conceived in the spirit of antique art, is distinguished by simplicity and beauty of design and perfection of workmanship.

Sarcophagus Fig. 2, in the Campo Santo in Genoa, the recent work of a skillful Italian sculptor, is a fine specimen of the style of modern art in Italy. Her artists, inspired by the best models and imbued with the traditions of national style strive to revive in their compositions the exuberance of fancy and the delicacy of ornament which we admire in the cinque cento work, and to attain the same degree of perfection in the treatment of and execution in marble by taking advantage of all the exquisite properties of that noble material. They are frequently successful in their efforts, and thus the Italian cemeteries show to-day a quantity of most remarkable monuments, besides others in which the artistic routine shoots beyond the mark, indulging in the deception and vagaries of a rude naturalism.

Fig. 1.

Fig. 2.

SUGGESTIONS IN DECORATIVE ART.—MARBLE SEPULCHRAL MONUMENTS, GENOA.—*From the Workshop.*

A variety of magenta has been introduced which is quite unaffected by contact with acids.

AN ARTIFICIAL STONE.

ACCORDING to *Dingler's Polytechnic Journal* a patent has been recently granted in Germany to Dr. Ternikow for the production of artificial stone, the chief constituents of which, sand and slaked lime, are known to show great resistance to atmospheric influences. By boiling (according to the patentee), a combination of silica and lime takes place; and the hardness of the mortar, petrified by aqueous vapor, even increases by absorption of carbonic acid from the air. Specimens showed throughout the hardness of good natural sandstone; they were about a year old, and must have gained in hardness, for shortly after casting they could still be cut with the knife. Cracks and fissures were nowhere observed, and are hardly to be expected in future, as the combination of lime and sand, under the action of hot water, is effected only at such low temperatures (between 250° and 300° Fahr.) that a reduction of hydrate of lime to free caustic lime cannot have taken place. As regards the cost of production, the price of the raw materials—eighty to ninety per cent. sand, and ten to twenty per cent. slaked lime—will scarcely be higher than that of clay for bricks. The time of heating is nearly the same in both cases, but while the temperature required for bricks is nearly a white heat, 300° Fahr. is sufficient for the mortar stone; thus there is considerable saving in fuel. The mode of forming the prism-shaped stones is similar to that of machine-made bricks where they are pressed through a mouthpiece.

GALLEINE AND CŒRULEINE.

By M. DURAND.

GALLEINE and cœruleine, new coloring matters derived from pyrogallic acid, were discovered by Baeyer, who published their reactions in 1871. Since that date no important publication on the subject has been made; indeed, Baeyer described the preparation and the properties of these compounds with such distinctness that the work was complete from the very outset.

Three years after this publication the firm of L. Durand & Huguenin, of Bâle, undertook the manufacture of these products, and sent its first samples in June, 1874, to M. Horace Kœchlin. The result of his researches was that the oxide of chrome was the best mordant for galleine and cœruleine, and that both for dyeing and printing the latter ought to be mixed with bisulphite of soda

Galleine.—Galleine is obtained by the reaction of phthalic acid upon twice its weight of pyrogallic acid. The mixture is kept at 374° to 392° Fahr. till the mass hardens. The crude product of this reaction is treated with boiling water in order to extract portions of pyrogallic and of phthalic acid which have escaped conversion. The product is dissolved by the aid of an alkaline carbonate, and precipitated with an acid, and is thus obtained in the paste-like state necessary for its use as an application color.

Galleine is sparingly soluble in boiling water, to which it nevertheless imparts a vinous red tint; it is, practically speaking, insoluble in cold water, but dissolves very freely in hot alcohol, the concentrated solution being of a mahogany color. Caustic alkalies dissolve it with a blue violet color. These concentrated solutions are rapidly transformed in contact with the air; they lose their blue color and deposit brown matters.

Galleine is variously affected by the metallic acids. The oxide which gives the most beautiful shades is chromic oxide, as M. Horace Kœchlin directs in the subjoined receipt for a steam color:

Galleine in paste	35 quarts.
Gum water	17½ "
Acetate of chrome at 18° B	1¾ quart.

Care must be taken to print both galleine and cœruleine upon cloth prepared with sulpholeate of ammonia.

Galleine dyes both cotton and wool equally well, provided the fiber is saturated with oxide of chrome.

This is easily effected by mordanting with chrome alum, or by taking alternately through chromate of potash and bisulphite of soda, or over the fumes of burning sulphur.

Cotton mordanted with oxide of lead dyes up also a very fine violet gray color. The dyeing, after mordanting, is done as with madder, adding to a water the quantity of ware necessary to obtain the shade, and gradually raising the temperature to a boil. After dyeing, the shade may be developed by a hot soaping. These colors have a solidity only rivaled by madder and indigo.

Upon wool galleine gives in printing the color of extract of orchil, though a little less blue. With the addition, however, of methyl violet or of alum similar tones may be obtained. At present the price of galleine is too high, as compared with the price of extract of orchil. This application of the new color, therefore, offers no practical interest.

Cœruleine.—This green coloring matter is a derivative of galleine, and both in its use and its properties it presents the same peculiarities, requiring the same mordants and the same precautions in dyeing and printing.

Its insolubility in water is still greater than that of galleine, and it is necessary to develop it by a slight reduction, which M. Horace Kœchlin obtains by the addition of bisulphite of soda, either in the dye-beck or in the mixed color for printing. The following is the color for printing as directed by this chemist:

For Wool—	
Cœruleine	17½ pints.
Gum water	52½ "
Glycerine	52½ fl. ozs.
Bisulphite of soda	34 "

The last article is added only the moment before it is used.

For Cotton—	
Gum water	17½ quarts.
Cœruleine	7 "
Bisulphite of soda	1¾ pint.
(To be added on using)—	
Acetate of chrome (at 18° B.)	3½ pints.

With additions of alizarine berries (or any other yellow color) or of catechu these receipts may be converted into bronzes, olives, mosses, etc., which, as compared with aniline greens and logwood, have an advantage in solidity which the makers of furniture prints fully appreciate. These new colors can be used with the greatest ease in resist styles.

M. Kœchlin recommends also in printing, as a mordant, yellow prussiate, which may be used at most in the proportion of 8¾ ozs. of prussiate per 1¾ pint of cœruleine. This maximum quantity gives shades rather too blue, due to the simultaneous development of Prussian blue, which disappears on soaping, and leaves a tone more gray, but of an intensity proportionally greater than that which is fixed with oxide of chrome.

For dyeing wool and cotton exactly the same procedures are required as for galleine, only to obtain good results the cœruleine should be stirred up with 4 lbs. 6 ozs. bisulphite of soda, at 40° Baumé, to 2 lbs. 3 ozs. of cœruleine. It is even recommended to let this mixture stand for some hours before adding it to the dye-beck.

Cœruleine has the property of becoming reduced like indigo, and of reoxidizing itself on exposure to the air, resuming its original color upon tissues saturated with the product of reduction, which permits this means to be used either for printing or dyeing. The best reducing agent is zinc powder, along with a little ammonia.

The dyes and impressions obtained with cœruleine are very fast as regards air and soap, which they resist as well as do the alizarine colors. The cloth manufacture will doubtless find in this ware an excellent tinctorial agent for dark green cloths which require great solidity.

Cœruleine is obtained by the action of concentrated sulphuric acid upon galleine. For this purpose 1 part of dry galleine is heated with 20 parts of sulphuric acid to 392° Fahr. The product of the reaction is run into water, and washed until perfectly neutral.

Cœruleine is affected neither by the caustic alkalies nor by acids. It is the only green dye, natural or artificial, which presents these precious qualities.—*Bull. de la Soc. Ind. de Mulhouse.*

OZOKERITE.

AT the Vienna Exhibition of 1873 was met with for the first time an interesting substitute for beeswax, ceresine, or mineral wax, which was exhibited by three Austrian firms. In the official report it was actually stated that this article was a mixture of common beeswax with more or less paraffine. This misstatement has not prevented other establishments from entering upon the manufacture of this substance, which is capable of serving as a substitute for beeswax in all its technical applications. The raw material for ceresine is ozokerite, otherwise known as earth wax, which is found chiefly in Gallicia, on the northern slope of the Carpathians, besides in Moldavia, Hungary, England, and Russia, but the first place is the only source of importance, as far as the manufacture of mineral wax is concerned. At Boryslaw, the main place of production, ozokerite is raised from about 2,000 mines, though at one time 12,000 are said to have existed, which are all arranged and worked in the most primitive manner, and with incredible negligence.

The ozokerite is found in masses or beds of variable thickness, between clay and a sandy shale, and varies in color from yellow and greenish brown to black brown. The raw ozokerite is first, in order to free it from earthy and stony matter, melted over an open fire, or by steam, and is then known as prim-wax. The purest kinds are used for preparing ceresine, while inferior qualities are worked up for paraffine. The manufacture of ceresine consists in heating prim-wax with one-fifth of its weight of sulphuric acid at a temperature of 284° to 320° Fahr. After complete removal of the acid it is smelted with the carbonaceous residues from the prussiate of potash works, and the mass while still fluid is finally filtered. From 100 parts of the best prim-wax 60 to 70 parts of ceresine are obtained. In appearance it closely resembles bleached beeswax; if it is desired to be of a yellow cast it must be colored. The production of ozokerite in Gallicia amounted in 1875 to 44 million lbs., of which Boryslaw alone yielded nine-tenths.—*Chemiker Zeitung.*

MALACHITE GREEN.

By O. DOEBNER.

To two molecules of dimethylaniline mixed with about half of its weight of chloride of zinc is gradually added, at a gentle heat, one molecule of benzotrichloride. After the reaction is over the deep-green mass is freed from foreign matter by treatment with watery vapor.

The coloring matter thus formed dissolves in water, especially hot, but more readily in alcohol, with a deep-green color, and possesses all the properties of a good dye. By treatment with soda lye, and shaking with ether, the base of the color may be obtained in a free state. On evaporation of the ethereal solution it is left as a reddish-brown oil, which evaporates slowly, and shows no disposition to crystallize. It is readily soluble in ether and alcohol; its salts dissolve in water with difficulty, but readily, and with a green color in alcohol. On the addition of an excess of concentrated mineral acid the green color passes into a yellow, but is restored on the addition of much water. The green solution is completely decolorized by heating with zinc and muriatic acid, but the green color is restored by exposure to the air, and more readily by oxidizing agents.

MENDING PLATINUM CRUCIBLES, ETC.

MR. THOMAS GARSIDE says: Some months ago I had a platinum dish, which had a small hole on the side near the bottom, and the dish was consequently useless for most purposes. I was about to consign it to the old platinum, when it struck me that this metal being "weldable," I might manage to repair it. Having already a mould for this dish, made of plaster of Paris, and not of wood, this served admirably as an anvil. I then cut a piece of moderately thin platinum foil, about 3 m.m. diameter, and rubbed this and the part of the dish where the hole was with sea-sand until perfectly bright and clean. Having fixed the dish and its mould in an upright position, I laid the platinum foil over the hole, and directed the flame from a table blow-pipe upon the spot. A pair of scissors served as a hammer, and by gently tapping with these the two pieces of platinum united perfectly, and made so neat a joint that one would scarcely observe it unless one's attention was called to it. I have used the dish for all kinds of purposes since, but the union is as good as ever. In the above operation the plaster of Paris mould, although very dry, was split and cracked by the heat in all directions, nevertheless it had sufficient cohesion to last until the operation was concluded. I find that platinum wires are very easily joined in this way.

POISONOUS GLOVES.

BRONZE-GREEN gloves are fashionable in England, and the London *Times* recites the experience of a girl of seventeen whose hands were so severely poisoned by the arsenic in the dye that for three weeks she was compelled to carry them in a sling, suffering acute pain and being unable either to feed or dress herself, and at the end of that period they were still swollen to double their natural size.

ALIZARINE COLORS.

By H. W. VOGEL.

ALIZARINE blue dissolves with an indigo blue color in water to which ammonia has been added. If supersaturated with nitric acid the solution turns a brick red. Amylic alcohol quickly extracts the coloring matter from an acid solution, but from an alkaline solution with difficulty. Alcohol dissolves the coloring matter in a perfectly neutral condition with a violet color. If mixed with ammonia the solution turns blue like a solution of bluestone. For the detection of this dye ware it is advisable to heat the dyed goods with dilute muriatic acid, to extract the coloring matter from this acid solution with amylic alcohol, when it may be examined with the spectroscope or submitted to chemical tests.

Alizarine orange (nitralizarine) in an alcoholic solution is colored reddish by ammonia, pale yellow by nitric acid, and a beautiful rose color by caustic potash. From dyed goods it is extracted exactly like alizarine.

Malachite green closely resembles aldehyde green in its optical behavior, but differs in its chemical characters. It is much more easily soluble in alcohol, and the solution has more of a blue cast than that of aldehyde green. Malachite green is almost instantaneously discharged by ammonia, while aldehyde green turns gradually blue.—*Berichte der Deutsch. Chem. Gesell.*

THE SYNTHESIS OF INDIGOTINE.

AT last the goal, to which such a number of the most eminent chemists have been tending, has been reached; the coloring matter of indigo has been artificially prepared from a derivative of benzine, and henceforth we may count it among the coal tar colors. We shall certainly see later on that this can only be said in a scientific sense, and that, in all human probability, the Bengal ryots will continue to supply indigo to the European market, little disturbed by the European gas works in their chances of earning a living; but for all that it cannot be gainsaid that science has celebrated a new triumph, and that the second of the most important vegetable coloring matters no more defies the art of chemistry than the coloring matter of madder has done. As in the case of artificial alizarine, the discovery of the synthesis of indigotine is not the result of a happy accident, but the crowning of long-continued efforts, carried out on a strictly scientific basis. This recent discovery is so far even more meritorious than that of artificial alizarine, as the obstacles on the way were far more formidable. It has, however, come to pass as it ought to be; this discovery was reserved for the same chemist who for many years past has studied the chemistry of indigo in its purely scientific aspect more than any other man living, and who has been the first to open out the road for inquiry into the inner constitution of indigotine—the celebrated Prof. Baeyer, of Munich, the worthy successor of Liebig in the same place. Many years ago he had shown how indigotine can be traced to a substance containing no oxygen, to which he gave the name *indol*, and the formula C_8H_7N, and how by successive stages oxygen is added to this compound till isatine is reached, from which indigotine is derived by a reducing action again. But it was tantalizing that, although both isatine and indol could be obtained from indigotine, the reverse reaction defied all efforts. Baeyer some time ago had succeeded in artificially preparing indol, and he had also succeeded in converting isatine into indigotine, to be sure by a very complicated and awkward process; but the gap between indol and isatine seemed incapable of being filled up synthetically, although analytically, that is descending from isatine to indol, had long been accomplished. At last the missing link has been found, and at the same time Baeyer has discovered a much simpler way of passing from isatine to indigotine, so that it is now in the power of every chemist possessing the usual laboratory appliances to prepare indigo artificially for himself. Baeyer's communications are contained in the *Berichte* of the German Chemical Society for 1878, pp. 582, 1228, and 1296. He starts from phenylacetic acid, a compound well known for some time, and easily prepared synthetically itself in four or five different ways. This acid, by being converted into a nitro-product, and again reduced, yields oxindol, $C_8H_7N_2O$, a compound intermediary between indol and isatine. Oxindol is converted into nitrosoxindol, this again into amido-oxindol, and by oxidizing the latter isatine, $C_8H_5NO_2$, is obtained. Isatine, when treated with phosphorous pentachloride, and then with ammonium sulphide, at last yields indigotine. Even from this short summary it will be apparent that the synthesis of indigotine is an extremely roundabout process, and of however great scientific merit and interest, certainly not destined to become a commercial operation. Still, almost the same might have been said when Graebe and Liebermann found out the synthesis of alizarine, and yet the ingenuity of technical chemistry has already mastered this process to such an extent that the yield of alizarine from the original raw material, anthracene, is almost 90 per cent. of that which can be computed from the formula; how far in other respects the battle has gone against the natural product from madder is well known to all your readers. But it is the opinion of this writer, which (as he can fully confirm from personal intercourse) is entirely shared by one of the discoverers of artificial alizarine, that the two cases were altogether different. In madder we had a material costing (before the competition of artificial alizarine) about 25s. per cwt., but containing hardly one per cent. of coloring matter, which accordingly actually cost about 25s per pound. Moreover, the coloring matter in madder is so much mixed up with foreign matters that it necessitated the complicated and risky operation of dyeing in the beck, even in printing, and the beauty of the color was also seriously impaired by these impurities. No wonder that artificial alizarine, which is now obtained in a state of almost perfect purity, with any desired admixture of iso and flavopurpurine, fit for steam printing, and at a price of about 10s. per pound of real coloring matter, has almost killed the cultivation of madder, and deals a serious blow to the countries depending upon the latter. No such thing can happen with indigo. Here we have a material costing from 3s. to 5s. per pound, but containing up to 70 per cent. of real indigotine, that is to say, a state of purity which will not easily be surpassed by any artificial product. There is, consequently, really no margin upon which any artificial production of indigo might base its hopes of competition, and, as we have said before, in all human probability artificial indigo will remain a scientific curiosity of the highest order, but nothing beyond.

[We have received the above communication from a most highly valued correspondent in Switzerland, who kindly promises us further communications on the most recent improvements in the manufacture of artificial colors.—*Chemical Review.*]

HOW TO MAKE A WORKING TELEPHONE.—BY G. M. HOPKINS.

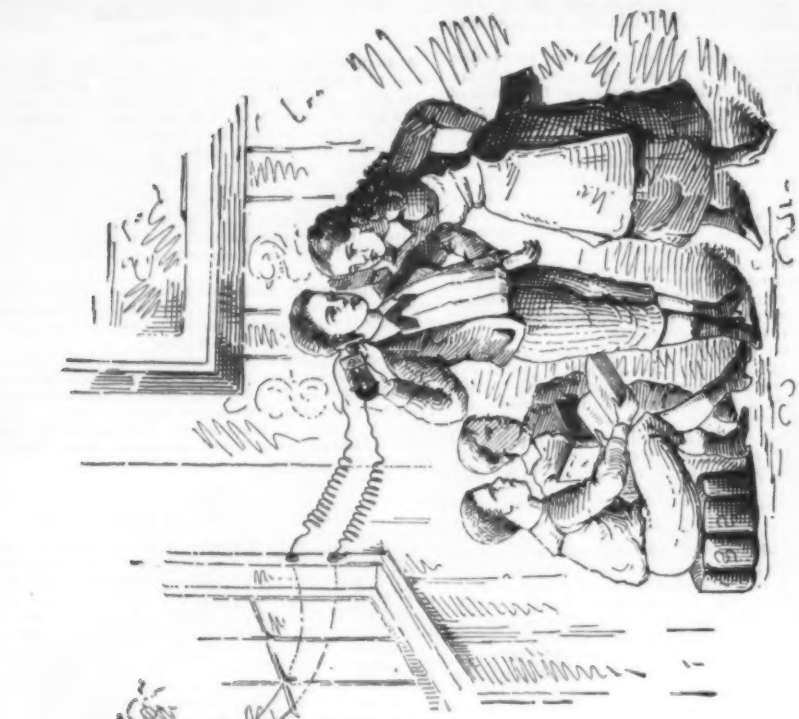


Fig. 1.

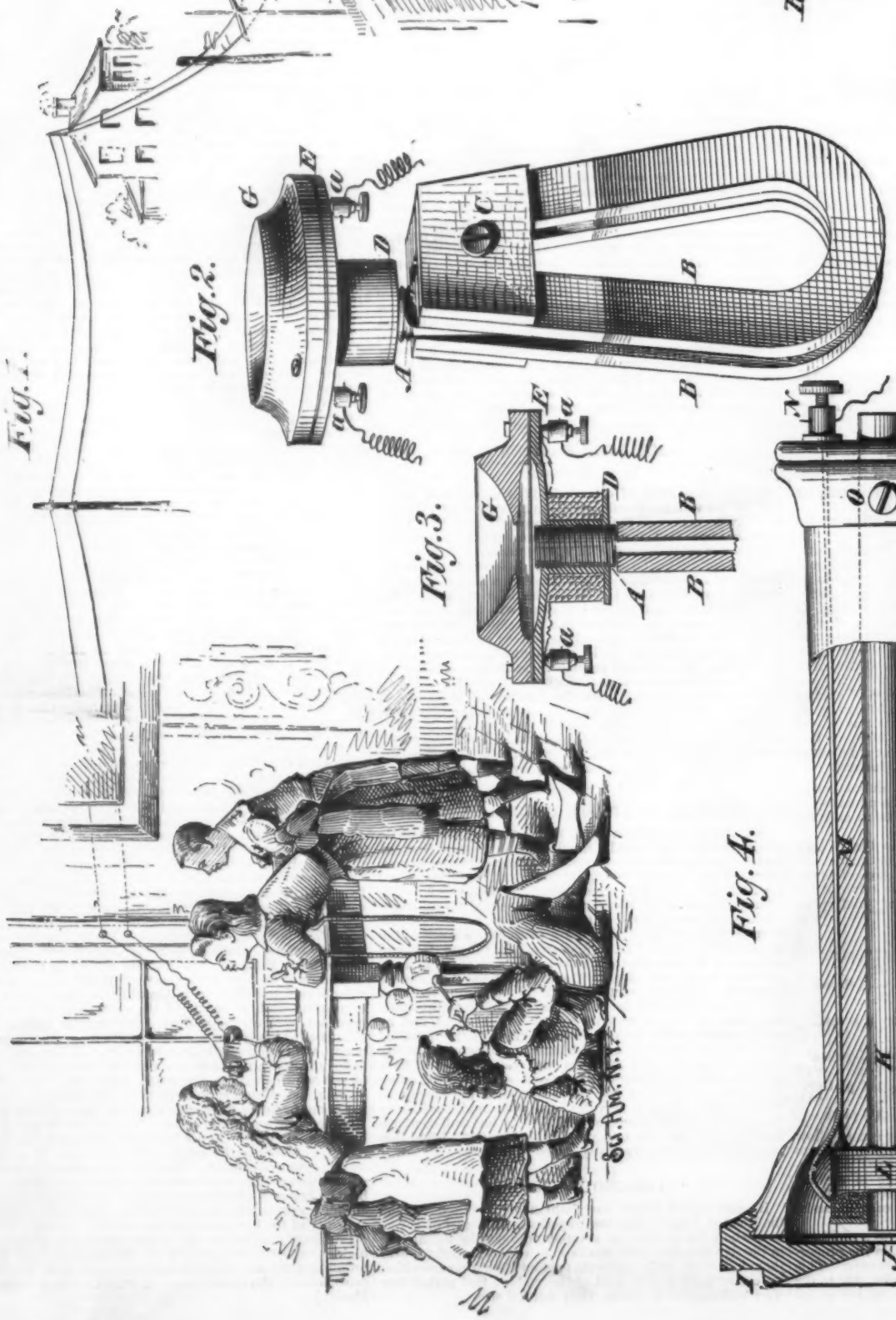


Fig. 2.

Fig. 3.

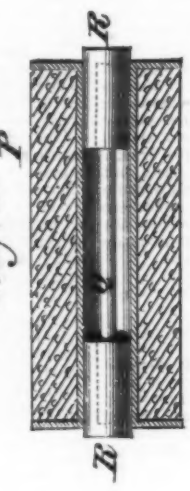


Fig. 5.

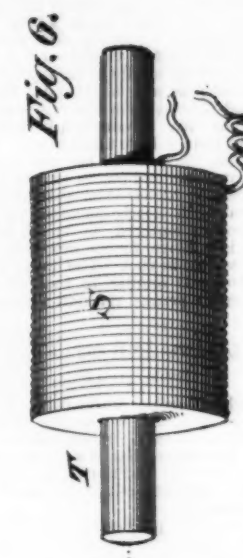


Fig. 6.

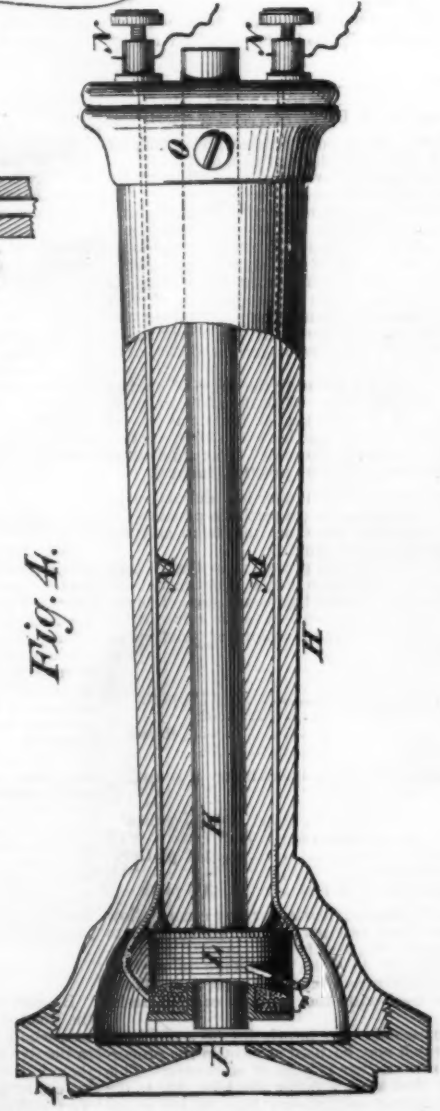


Fig. 4.

HOW TO MAKE A WORKING TELEPHONE.

By GEORGE M. HOPKINS.

As most if not all of the readers of this journal are familiar with the principle of the articulating telephone, and as a thorough understanding of the principle upon which it operates is not essential to the construction of the instrument, I will omit the details of the principle of the operation, and will proceed at once to describe how a telephone may be easily made.

Figure 1 in the engraving on page 2260 shows the telephone in active operation. Figure 2 is a perspective view of a telephone employing ordinary U magnets.

Figure 3 is a detail sectional view of the same. Figure 4 is a side elevation partly in section of a telephone that is essentially the same as Bell's. Figures 5 and 6 represent devices for magnetizing the bars for telephones. Figures 2, 3, and 4 represent the actual size of the instruments.

The telephone shown in Figures 2 and 3 is very easily made. The two U magnets, B, which may be of the size shown in the engraving, or larger or smaller, may be bought at almost any hardware store or toy shop, and the soft iron core, A, upon which the spool, D, is placed, may be screw-threaded externally and flattened to fit between the magnets by any blacksmith or worker in iron. The iron core, A, should be ⅜ inch in diameter, and the flattened end which extends for about 1 inch between the magnets should be ⅛ inch thick, and the other poles should be separated the same distance by a block of wood.

The two magnets are firmly clamped together by the plates, C, and the screw, which extends through one of them into a tapped hole in the other. The magnets must be arranged with like poles in contact with the soft iron core, A.

The wooden spool, D, is 1 inch in diameter and ⅝ inch long, and has upon its outer end a concaved flange, E, having an annular bearing surface for the diaphragm, F. The flange is 2¼ inch in diameter, and the annular bearing surface is ¼ inch wide, leaving the middle portion of the diaphragm, which is 1¾ inches in diameter, free to vibrate.

The spool is wound with ¾ oz. of No. 36 or No. 38 silk covered copper wire, and the ends of the wire are fastened to small binding screws, *a*, that project from the back of the concave flange, E.

The diaphragm, which is simply a disk of very light tinned iron or ferrotype plate, is of the same diameter as the flange, E, on which it is placed.

The mouthpiece, G, is secured to the flange, E, by three small screws; the diaphragm being clipped at three equidistant places to admit of this mode of fastening. The diameter of the opening in the mouthpiece is ½ inch, and the mouthpiece, like the flange, must be concave.

The distance between the diaphragm, F, and the end of the soft iron core, A, is adjusted by screwing the spool, D, up or down on the core. Probably the best adjustment is to place the diaphragm as near the end of the core as possible without causing a jar when the instrument is spoken to.

This telephone, when connected with another of the same kind by means of two carrying wires secured in the binding posts, will be found to work admirably. A single wire may be used to connect one binding post of each telephone, the other binding post being connected with the gas or water pipe, or with a ground wire properly connected with large metallic plates buried in earth that is constantly moist.

The telephone thus described is more easily made than that shown in Figure 4, as the trouble of magnetizing the steel is avoided.

By substituting for the iron core, A, a bar magnet ⅜ inch diameter and 5 inches long, and threaded at one end, a very compact, easily adjusted telephone is produced.

The telephone shown partly in section in Figure 4 consists of 5 principal parts—the handle, H, the mouthpiece, I, the diaphragm, J, the magnet, K, and the bobbin, L.

The handle is bored longitudinally through the center to receive the round bar-magnet, K, and there are two small holes at opposite sides of the magnet, through which pass the stout wires, M, which are soldered to the terminals of the bobbin, L, and connected with the binding screws, N, at the end of the handle. The handle, H, is chambered to receive the bobbin, L, and has a mouthpiece, I, and diaphragm, J, which are of the same size as previously described.

In the present case the mouthpiece or cap is screwed on the handle, but it may with equal advantage be fastened by means of small screws, as shown in Figs. 2 and 3.

The bobbin should be filled with about ¾ oz. of No. 36 or No. 38 silk covered copper wire, and the magnets should be placed as near the diaphragm as possible without touching it, and when properly adjusted it is clamped by a screw, O, at the smaller end of the handle. The bar magnet, K, is ⅜ inch diameter and 6 inches long.

The connection between two or more telephones and the ground connection is made in the manner before described.

There are two methods of magnetizing the bars which I will describe. The first thing to be done is to harden and temper the bar. This is done by heating it to a dark cherry red and plunging it in cool water, and afterward drawing the temper to a straw color. The first method of magnetization consists in placing upon each end of the tempered steel bar, Q (Fig. 5), a soft iron cap, R, and inclosing the bar thus armed in a helix, P, made of three or four layers of No. 16 insulated copper wire, and connecting the helix with 4 or 6 Bunsen cells arranged for quantity. The helix should extend to the ends of the soft iron caps, and it must be disconnected from the battery before withdrawing the magnet.

Another method consists in passing a helix, S, over the bar, T (Fig. 6). The helix, S, is composed of about 10 ozs. of No. 16 insulated copper wire, and it has an internal diameter of ½ inch and a length of about 1½ inch.

The helix being connected with a battery of 6 Bunsen cells, it is drawn over the bar from one end to the other, and returned to the middle of the bar, when the battery should be disconnected. These are easy methods of magnetization, and may be practiced by any one having the appliances, but the magnets will not possess the strength exhibited by magnets charged by a powerful magneto electric machine.

The telephone line wire should be insulated in the same manner as telegraph wires. For short lines a return wire should be used; for long lines a ground connection will answer.

APPLICATION OF THE MICROPHONE IN SURGERY.

The microphone has been successfully employed in the detection of urinary calculi, and it may probably serve also to indicate the position of the fragments of projectiles. —*Les Mondes.*

ELECTRIC LAMPS IN PARIS.

IN a letter to the New York *World*, Prof. Silliman gives a detailed account of the development of electric lighting and its applications in Paris. He says:

All the world—meaning Paris and her guests—have seen the magnificent illumination by the electrical lamps of Jablochkoff, unless, indeed, they have been so blinded by excess of light that they have seen nothing. A walk up the Avenue de l'Opéra of a dark night from the Palais Royal to the Grand Opera House, or in the Orangeries of the Garden of the Tuileries, or along the shops of the Belle Jardinière, or by the Arc de l'Etoile will dazzle the strongest eyes with the splendor and penetrating intensity of the great globes of ground glass which temper the insufferable solar glare of the unprotected light. I never see these beautiful globes without being reminded of that familiar class-room experiment of the chemical laboratory when phosphorus is burned in a glass sphere filled with oxygen, and the critical point arrives when the whole glowing space is filled with the burning vapor of the volatilized phosphorus, and the blaze of glory for the moment seems above the brightness of the sun. So in these electrical lamps the same impression is made, save that the seconds of duration for the phosphorus are extended to hours for the electricity. Objects viewed by the electrical light are seen in their natural colors, and such is the effect of refraction and reflection in producing a general diffusion of light that no sharp shadows are seen, as was the case when only a single focus of unblenched electrical light was employed. The lamps are set so high that there is no occasion to look *at* them, except the fascination of the thing, while yet the effect is a novelty. The whole street, to the tops of the loftiest houses, is ablaze with a flood of beaming light which makes the street seem like the scenes of some grand play at the opera.

Everybody says, when this effect is first seen here: "Now is the dawn of a new era. Gramme and Jablochkoff are the real Prometheuses of mythology, and here is the heavenly radiance come down to earth. No more lurid gleams of murky gas to despoil our city treasuries and juggle the people with those thimble-rigging meters which nobody trusts! Farewell to coal and all the smutty and ill-smelling tribe of hydrocarbons! We have seized the heavenly radiance of Apollo with the thunderbolts of Jove, and can bid defiance to street mains and all the unsightly and unsavory concomitants of the gas-house." This is about the talk one hears, and naturally enough; but science teaches us to keep cool (even in these hot days!), and we are advised to investigate the subject calmly before we sell our gas stock or take up the shares of the "Société Général d'Electricité Anonyme." And what is the result? I cannot state it better than by quoting the words of M. Hyppolyte Fontaine, of Paris, the Engineer of the Gramme Company and author of an elaborate volume on electrical illumination. Speaking at the last meeting of the London Institution of Mechanical Engineers, M. Fontaine says: "The electric light does not interfere with gas light, nor with oil light, nor with candle light. It will not revolutionize, as has often been averred, the question of lighting, destroying what is now in use and monopolizing every industrial application, domestic and public. The electric light has its place marked out for it under many circumstances; but, far from diminishing the consumption of the other lights, it will lead to their further development by demonstrating the advantages of a more powerful and more complete illumination." These words, coming from one whose position would naturally prompt him rather to exalt his office, express the simple truth as we understand it to-day. The whole thing is in its infancy. We are dealing with a wonderful power which is as yet but imperfectly in our control, and we have very much to learn about it. How recent its industrial application is will be better seen if we remember that in 1874 there were in France only four applications of it to industrial uses; in 1875, 12; in 1876, 85; in 1877, 350, and at present there are upward of 500 applications of the light—amounting in intensity to more than a million and a half of candles. This is not much compared with the total illumination, public and private, of this great city, but it is a great deal when it is considered how recently the new light made its appearance and how many difficulties attend the introduction of all new inventions. By virtue of its remarkable space-penetrating power it is specially adapted for various purposes where illuminations previously known were inadequate. With the aid of a lenticular projector it acquires a prodigious power of reaching into space and distinguishing objects many miles distant. By the naked light, unaided, spacious halls or extensive yards may be lighted up so that by night as by day the movements of merchandise or manufacturing operations on a large scale or work in the open air may be followed up; while by the use of ground glass and by properly constructed reflecting ceilings, as in cotton spinning and other manufacturing establishments, a generally diffused and softened light may be obtained without sharp shadows, in which delicate operations may be as well conducted by night as by day.

Many questions are on the tongues of your readers, which I hope to answer before they are asked. For example: What is the source of this wonderful light? How is it produced and transmitted? What is its cost, as compared to gas, for example, for an equal intensity of illumination? What limits its production and economical application to human uses? And so on. It is important here clearly to indicate the distinction—which is a fundamental one—between the light of the voltaic are from a voltaic battery excited in the usual way by the action of acids upon zinc, etc., and the electrical light we are now considering and which is the result of magnetic induction, and which is simply the dynamical equivalent of mechanical force and depends not in any manner upon chemical action. Undoubtedly the earliest exhibitions of the electric light from the voltaic battery were those made with the deflagrators of Dr. Hare by Professor Silliman at New Haven in 1822, and subsequently on a magnificent scale at Boston in 1834, when an arc of over five inches diameter was produced by the simultaneous immersion of 900 large-sized couples of Hare's deflagrator. But no means had then been devised for the regulation of the electrical light to render it constant, and although the writer as early as 1842 used this light successfully to produce daguerreotypes, the progress of invention had yet to make further use of the discoveries of science before electrical illumination was possible. We need not follow now this branch of the subject further. Suffice it to say that the electrical light which we are now concerned with uses no voltaic battery, consumes no acids or other chemical agents, is, in short, the author of its own existence, so to speak, being nothing more than the equivalent of a certain amount of motion—mechanical motion converted into molecular motion, in other words, into heat and light, through the medium of magnetism. Long did men grope in the dark seeking to grasp the hidden thread connecting the magnetic force with the other known modes of electrical manifestation. The oldest of the three sisters magnetism, electricity, voltaism, it waited the birth of the latter before Oersted could perform the simple experiment of the "conjunctive wire" and demonstrate in 1819 the conversion of voltaism into magnetism (electro-magnetism), and Ampère could show its relations to terrestrial magnetism, and for Sturgeon, of England, in 1826, to produce the first electro-magnet of soft iron by winding it with Oersted's conjunctive wire formed into a spiral—the "helix." And here the march of discovery halted until about 1830, when Henry showed us how to produce electro-magnets of a power not before dreamed of, and following up his discoveries simultaneously with Faraday, they, without comparison of notes, fell upon the fundamental facts of electro-magnetic induction and the phenomenon of secondary currents and the *extra* current with its splendid spark. At this moment, 1831, appears Joseph Saxton, of Philadelphia, who, being in London at the time and acquainted alike with the researches of Hare, Henry, and Faraday, with his well-known mechanical skill constructed the first magneto-electric machine, which, by revolving an armature of soft iron wound with insulated copper wire before the poles of a permanent magnet, obtained a constant succession of brilliant sparks and powerful shocks. This apparatus of Mr. Saxton was afterward pirated by a man named Clarke, of London, and curiously enough another person of the same name—also an Englishman—twenty years before or more appropriated without acknowledgment the oxyhydrogen blow-pipe of Dr. Hare!

Here, so far as electrical illumination is concerned, the matter rested for many years. Inventors had all the material facts before them then as now, but so intent were they upon converting to some practical use the enormous magnetic power developed in masses of soft iron by the voltaic current—a very natural direction in which to follow up the suggestion of Henry's discoveries—that the less promising field of developing light from magnetism without the intermediation of chemical agency was quite overlooked and neglected. It is needless to say that the effort to obtain any valuable effects from the conversion of magnetism into mechanical motion was necessarily a failure, and in the present state of science no one would be justified in spending a moment of time or a dollar of money upon such a scheme. But given a definite source of mechanical force, required to evolve from it a certain equivalent of heat and light through the intervention of magnetism, and the problem offers entirely new features. Nay, more. Mechanical is thus converted into chemical force, and the electro-deposition of metals is now conducted probably by the water-wheel or the steam engine, through the intervention of magneto-electric induction, and the old acid batteries of Volta are laid upon the shelf. In this line of research we find especially the names of Ladd, Wilde, and Siemens in England, of Gramme in France, and of Wallace, Brush, and Weston in America. Let the question of priority of invention, of superiority in form of construction, and of conflicting claims among all these inventors rest for the moment; the grand and simple fact remains that, given any adequate source of mechanical motion and masses of soft iron properly mounted for revolution and armed with an adequate amount of insulative copper wire, we come from the simple multiplication in itself of that inconsiderable amount of magnetic force which exists in almost every mass of soft iron developed by simple rotation of the bobbins of such an apparatus, to such a volume and intensity of magneto-electricity as can be limited only by the power of the mechanical motor at command and by the inductive capacity of the soft iron masses within the environment of the insulated wires of soft copper, *provided* the revolution of the arbor is accompanied with suitable interruptions in the direct flow of the electrical stream. Without the use of technical language—out of place in a newspaper—and of good diagrams, which would be of little value without technical description, we can hardly make the subject more easy of comprehension to the average reader. What is the result? Considering the Gramme machine, for example—for we are in Paris, and the Gramme machine is unfortunately the only light-producing magneto-electric apparatus on exhibition; Weston has [illegible] machines here for electro-plating doing excellent work, but Wallace is not here, nor Brush, of Cleveland, and so America remains literally in the dark when she should have made a most conspicuous show of electrical illumination—only one more example of our too numerous shortcomings at this Exposition. But to return to the Gramme machine for our illustration. It is simple, powerful, and very compact. It has no delicate parts, liable to derangement; it can be set up anywhere in a few hours without any foundation, and it can be worked for months without delay or interruption. Like any other machine of simple rotation, the wearing surfaces need lubrication. It occupies only a space of about four cubic feet, weighs about 400 pounds, of which the copper bobbin weighs about 70 pounds, has a diameter of seven inches, and requires two and a half horse power to drive it, with 850 turns per minute. Such a machine develops an average illuminating power of about 5,700 candles. Its intensity depends on various circumstances of position, etc., and may vary between 2,400 candles and 8,400 candles, according to the mode of placing the carbon points with reference to the photometer. This is the type of machine in use for industrial purposes, for practical daily work in illumination of shops, railways, and streets. There is in the Exhibition a form of the Gramme machine at work which yields three times more light for equal quantities of matter in action than any of those which have been before tried in France, England, or elsewhere, on the authority of M. Fontaine. This machine weighs 441 pounds, costs £60 ($300), and yields a light equal to 30,000 candles! Notwithstanding its low price and wonderful performance, this machine cannot be commended for use, as the elements of durability are wanting in it. But of the form of the Gramme machine used in shops, it is affirmed that several hundred of these machines have been at work all the past winter, some of them without interruption, for underground operation, without costing a farthing for repair or maintenance except for lubrication.

I quote from a carefully prepared statement of Messrs. Heilman, Ducommen, and Steinlen the average cost per hour of four Gramme machines which have been run by them for four years. The charge for interest and depreciation is rated at 15 per cent. on the cost of four Gramme machines and the motor to drive them, viz.:

	D.
Carbon pencils burned	8·36
Steam consumed	3·42
Attendance	2·85
Interest and depreciation	43·45
Total	63·08

(To be Continued.)

DIPHTHERIA CAUSED BY BAD SEWERAGE.

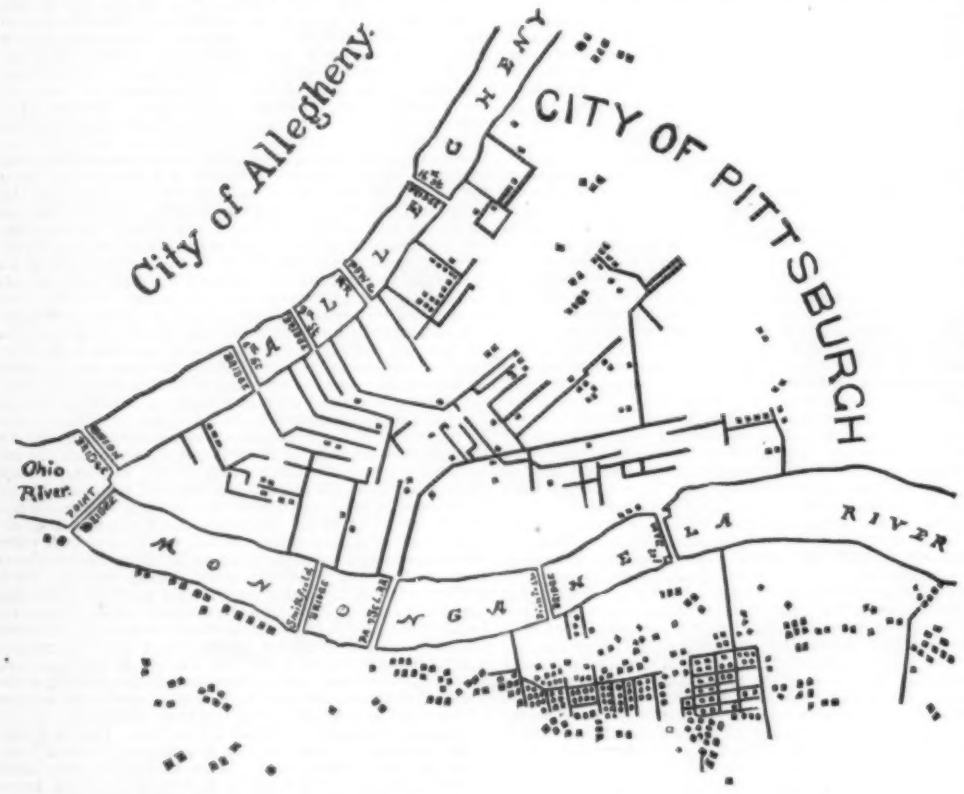
BELOW we give a synopsis of a paper read before the Pittsburgh Academy of Medicine, March 27, by Dr. W. Snively, Physician to the Board of Health, and reproduce from the Pittsburgh *Chronicle* a map showing the sewerage system of the city and the death rate in the several districts. The lines shown in the map represent the trunk and lateral sewers, while the dots represent the deaths and the localities in which they occurred during the five months of 1877, when the disease was epidemic.

The record for the month of August shows 54 deaths; September, 77; October, 113; November, 74, and December, 48; aggregating 366. Of this number, 141 occurred within the infected district.

The latter is of about ninety acres extent, and in form a triangle, bounded by Carson Street, Twenty-first Street and the base of the hill, which rises abruptly to an average height of 450 feet above low-water mark in the river. The average level of the district is 60 feet above low-water mark. During the last five months of the year there were 457 cases reported from this locality against only 399 from the balance of the city.

The sewers which are located in this district are defective in many respects The Twentieth Street branch, 2½ miles long, was extended in 1871 in such a manner that the older portion became choked at the point of connection.

About a dozen slaughter houses are located near the terminus, the offal and refuse from which are conveyed by it to the river Originally this sewer had no traps connected with the street drops, but the complaints of offensive emanations became so persistent that they have since been attached. In long periods of dry weather, unless suppliedwith water from the street hydrants, the drops become dry and are practically useless They are also constantly becoming offensive, owing to people throwing stale eggs, vegetables, and all sorts of material into the drop, under the delusion that they will be carried away. This sewer has no provisions for ventilation. Manholes are built at intervals, but are covered with tight fitting cast-iron lids.



DIPHTHERIA AT PITTSBURGH, PA., FROM BAD SEWERAGE.

The Washington Street sewer has a grade of one foot per 100. It has twenty-nine street drops, none of which are trapped. Until a few months ago it had not been cleaned since its construction in 1851—a period of 26 years. In August, 1877, the Inspector of the Board of Health reported it "choked" a distance exceeding 2,000 feet.

The Board of Health earnestly urged the authorities to have the sewer cleaned at once, but nothing was done until December. These choked and unventilated sewers naturally became filled with foul gases, which found their only vent through the houses in their vicinity, most of the connections being untrapped. Several heavy showers took place in July and August, 1877, sufficient, upon each occasion, to cause a large volume of water to be discharged from the steep hillsides into the sewers, and to drive the sewer gas into the dwellings. The date of occurrence of these disturbing events coincides in a very remarkable manner with the outbreak of diphtheria in this locality.

Dr. Snively concludes his paper as follows:

"That many of these deaths are to be referred to contagion is, of course, admitted, but we cannot ignore the fact that a very large proportion of these occurred in striking contiguity to the sewers, and particularly to the more elevated portions of them. Not alone upon the South Side, but throughout the entire city, we find this to be the case. Striking instances occurred in the Seventh, Eighth, Ninth, Eleventh, Fourteenth, and Fifteenth Wards. The disease did not prevail extensively in the most filthy and crowded localities, but mainly in those portions of our city drained by sewers."

In all during the year 1877 there were 900 cases of diphtheria and over 400 deaths.

The epidemic of last year placed Pittsburgh among the cities in the Union having the greatest death rate. Four hundred deaths from this cause, in a total of 3,400 deaths, with an urban population of not over 120,000, is a very serious state of affairs, especially in view of the fact that much of the mortality was preventable with ordinary care.

DIPHTHERIA.

PERIOD OF LIFE MOST LIABLE TO SUFFER FROM DIPHTHERIA.

FROM the ages at death of nearly 70,000 fatal cases given in the returns of the Registrar-General, I find that of every thousand fatal cases the age at death may be expected to be distributed as follows:

Under 1 year	90
1—5 years	450
5—10 "	360
10—15 "	90
15—25 "	50
25—45 "	35
45 years and upward	25

It will thus be seen that diphtheria is pre-eminently a disease of childhood, and this, taken in conjunction with the exceptional rapidity with which in some cases this disease prostrates the sufferer, has an important bearing upon one chief mode of dealing with ordinary infectious epidemics. I have repeatedly seen in reports on outbreaks of this disease that, in order to guard against similar outbreaks, a sanitary authority has been advised to provide an infection hospital. Now, no one appreciates more than myself the value and necessity for all classes of such institutions, but every case should sail on its merits, and I do not think an infection hospital would ever be of much use in this disease because of the age of the sufferers. Mothers will naturally not part with their children, nor indeed is it reasonable to expect them to do so.

DIPHTHERIA IS THE TYPE OF PREVENTABLE DISEASE,

partaking as it does of the characteristics of those two classes into which infectious disease may be divided. It is in its origin and dissemination as intimately connected with structural defects as enteric fever on the one hand, and on the other, like scarlatina, is very liable to spread by personal agencies. Moreover it has, I believe, an equal and somewhat similar claim with ague, to be considered a disease preventable by the removal of certain local conditions. When diphtheria gets an introduction to a house, if the children are living under good sanitary conditions, it generally falls lightly; but if the reverse is the case, and especially if they happen to be drinking excrementally contaminated water, in its occasional appalling fatality (greater than that of any of our ordinary infectious diseases of the present day) the disease reminds us of those epidemics of the middle ages, from which we are happily now free. I have in my own personal experience been called upon to investigate cases where, in one visitation to each house only, diphtheria has proved fatal to fifty persons in fourteen houses. If isolation, disinfection, and cleanliness are neglected, diphtheria will spread, and prove terribly fatal under certain bad sanitary conditions; if, however, disinfection and isolation are properly carried out, in no disease may we count upon more favorable results.

The general history of an outbreak of diphtheria is as follows: Either from direct importation or in certain localities spontaneously a case appears in a house. If the children are living under good sanitary conditions it is simply called sore-throat, and the children are not even kept from school. These throats are speedily transmitted, and become epidemic over the district, attracting little notice till, meeting with a family living under very bad sanitary conditions, some fatal cases occur. In other cases the first cases are fatal because being under bad conditions, and there is then less likelihood of an epidemic, as, the term diphtheria being used, precautions are taken.

My experience is that the severity of the disease is directly influenced by the conditions under which the individual attacked is living, but that the tendency of the infection to spread is much increased, as in typhoid fever, by the disease passing through an individual who happens to be newly resident in a diphtheria locality, and, as in typhoid fever, such persons are particularly susceptible. Of the sanitary defects which specially govern the *mortality*, the most potent is undoubtedly excrementally contaminated water, and in nearly every case in which the disease has carried off whole families I have found this defect; I have also seen the converse, where an epidemic did not prove fatal in a single instance in a large number of houses using a common supply brought in pipes, but proved fatal to eight children drinking water from two contaminated wells. In its dissemination diphtheria is governed by much the same laws as typhoid fever, and, like it, may be spread in various ways by excremental agencies. I do not think that any amount of filth will generate diphtheria, but that, except in certain special localities, diphtheria is always the result of importation.—*W. N. Thursfield, M. D.*

POINTS CONNECTED WITH DIABETES.

Lecture delivered at the Royal College of Physicians by F. W. PAVY, M. D., F. R. S.

IT is a minimum amount of sugar in the blood which is the character of health, and a larger amount which is associated with unnatural states. To maintain the minimum amount the liver exercises a sugar-detaining and sugar-assimilating function, and this prevents us from being diabetic. It has been asserted by Bernard, and my own observations confirm the assertion, that the blood of the herbivora contains no more sugar than that of the carnivora. Indeed, according to the results I have furnished in a former part of these lectures, the blood of the dog contains a higher proportion of sugar than that of the sheep or bullock. Now in the herbivora, besides the sugar derivable from an internal source, we have that to deal with proceeding from ingestion; and if the liver did not stop, as I contend it does, the passage of sugar into the general circulation, there ought to exist a marked difference adversely to what is noticed. The sugar which actually escapes from the liver is so small in amount that I cannot conceive it to have anything to do with the large operation of appropriation of this principle to force production that must occur as a part of the general phenomena of life.

Expressed in precise language, I would say that the liver is essentially a sugar-assimilating instead of a sugar-forming organ; and that when its assimilative action is properly exerted, so little sugar is allowed to pass into the general circulation that the quantity existing in arterial blood is insufficient for rendering the urine more appreciably saccharine than is observed in the healthy state: but that when its assimilative action is not properly exerted, sugar is allowed to pass, and in proportion as it does so the urine acquires a more or less marked saccharine character.

The question before us is one which resolves itself into the utilization or non-utilization of a certain kind—viz., the carbo-hydrate kind—of material. We know that in diabetes this material reaches the blood as sugar, and thence escapes unutilized with the urine. If in health it passed in a similar manner into the blood, to obviate its escape it must undergo appropriation in the circulatory system, and the difference between health and diabetes would then resolve itself into a difference in the capacity of appropriation within the circulatory system. This view, however, is not adopted by the advocates of the glycogenic doctrine, and the evidence afforded by observation is against it. We are therefore driven to the conclusion that the material in question must have a different destination under normal circumstances, and I contend that in reality the liver ought to detain and assimilate it instead of allowing it to pass as sugar into the circulatory system, and that it is by this action we escape being diabetic. Put in another way, it may be said that the sugar escaping in diabetes is the representation of the carbo-hydrate material which ought to be utilized in the system, but which, finding its way into the general circulation as sugar, is thence eliminated as it is. To escape being thus eliminated, it is obvious that the carbo-hydrate material in question must pursue some other path toward utilization than passage into the general circulation as sugar, and this is tantamount to saying that under normal conditions there must exist a capacity of appropriating carbo-hydrate material in this other direction equal to the disposal of that which is represented by the sugar escaping in a full-marked case of diabetes, and this embraces, if not all, certainly in the main, all the carbo-hydrate material which the system has to deal with. Not only, therefore, must there be this other power of disposal, but such power must be exercised, instead of the material being allowed to pass into the general system as sugar, as is represented under the glycogenic doctrine, to avert the manifestation of diabetes.

I have previously discussed what Bernard has said about the appropriation or destruction of sugar in the circulatory system, and have shown that my own analytical observations give no evidence of any significant amount of destruction occurring. It may be assumed—as, indeed, the aggregate of my results indicated—that a minute disappearance takes place. With an organic principle like sugar, susceptible of undergoing change such as occurs in the lactic acid fermentation, it is scarcely to be expected that it would remain uninfluenced by the molecular actions going on around it; but that nothing of a nature to be compatible with the large disposal of it as an alimentary principle that must ensue is to be recognized is, I consider, proved by the evidence that has been already adduced. If the destruction of sugar occurred within the circulatory system of the herbivorous animal to an extent sufficient to account for the disposal of that which is derived from ingestion as well as from alleged formation, what, it may be asked, ought to be the condition in the carnivorous animal which does not receive the supply of sugar from without? Surely, if the destruction is carried out with sufficient fullness to keep down the sugar in the system of the herbivorous animal, it ought to be equal to the entire removal of the sugar contained in the arterial blood during its passage to the veins in the case of the carnivorous animal. In reality, the sugar that has to be dealt with in the blood shows itself to be as much beyond the capacity of destruction in the peripheral vessels in the carnivorous as it is in the herbivorous animal. No material difference, in fact, is to be traced in the state of things in the two groups of animals. In both cases alike the sugar contained in arterial blood reaches the veins without undergoing any material diminution, and thence must needs circulate through the system over and over again. Whatever destruction occurs can only fulfill a subsidiary office. Admitting that the operation is to some extent carried on, it is altogether wanting in the magnitude required to be associated with the appropriation of sugar as a force-producing agent in the body.

My own version of what occurs is this: We know that in a large number of animals the food is of such a nature as to supply sugar in notable quantity for absorption from the alimentary canal. A portion of this may reach the thoracic duct through the absorbents, and thence be conveyed to the general circulation, accounting in part for what sugar is there encountered. The main channel, however, for the

passage of sugar from the alimentary canal appears to be the blood vessels, and transmission into them is permitted by the property of diffusibility which this agent possesses. Absorbed into the portal system, it is conveyed to the liver, where it becomes, if not entirely, certainly almost entirely, checked in its onward progress, and prevented from entering the general circulation. I have shown, by observations which have been for a long time made known, and which I need therefore here only allude to, that sugar leads to an increased accumulation of amyloid substance in the liver. The evidence adducible points to the occurrence of a direct formation of amyloid substance from absorbed sugar. As the sugar is passing through the capillaries of the organ it becomes picked out by its cells and converted into the principle I have mentioned. Nothing could be more favorable than the conditions that exist for the occurrence of this operation. Surrounded as the capillary vessels of the lobule are with rows of secreting cells, the blood is brought into the closest proximity with the secreting element, and thus most advantageously placed for selective action to be exerted.

Micro-chemical observation shows that the amyloid substance of the liver is confined to the cells, and doubtless immediately the sugar is abstracted from the blood it is transformed by the action of the cell into the principle named, for otherwise the organ would give evidence of the presence of sugar in a manner that it is not found to do. Moreover, sugar is a diffusible substance, and would not therefore be retained. Amyloid substance, on the other hand, belongs to the class of colloids, and with its non-diffusibility possesses the properties which physically contribute to its retention in the cells, where it presumably undergoes a change which forms one of the links in the series leading up to the final issue—the utilization of sugar as a force-producing agent in the system.

As regards, then, the sugar derived either directly or indirectly from the food and absorbed from the alimentary canal, my proposition is that under normal circumstances it is stopped by the selective or secreting action of the cells of the liver, and in these transformed into amyloid substance. When not thus stopped it reaches the general circulation, and as a result gives rise to a saccharine impregnation of the urine, standing in proportion to the amount of sugar absorbed from the alimentary canal. This is just the condition that exists in diabetes, and it is well known that in this disease the eliminated sugar stands in relation to the amount of sugar or sugar-forming material ingested.

But it is not only from the sugar derived from the food that the amyloid substance of which I have spoken takes origin. I do not know of any evidence to show that it is formed from fat. Nitrogenous matter, however, undoubtedly is a source for it. This is proved by its existence in well-marked quantity in the liver of the animal-feeder kept upon lean meat. In diabetes also, where a severe form of the complaint exists, sugar is voided upon a strictly animal diet, and such sugar may be put down as taking origin from the abnormal descent of the amyloid substance derived from nitrogenous matter. It is known that ingested nitrogenous matter leads to the production and elimination of urea, and it is believed that the production occurs in the liver. A splitting up of the nitrogenous compound ensues, and its nitrogen, appropriating a certain amount of its carbon, hydrogen and oxygen to form urea, leaves a complementary portion of carbon, hydrogen and oxygen, from which it may be assumed amyloid substance is generated. If we take the percentage composition of albumen and give to the nitrogen the amounts of the other elements required to form urea, we see the amounts of carbon, hydrogen and oxygen that may be applied to the purpose named. This table affords a view of how the matter stands:

Urea and Complementary Residue derivable from Albuminous Matter.

	Albumen.	Urea.	Residue.
Carbon	53·50	6·64	46·86
Hydrogen	7·00	2·21	4·79
Nitrogen	15·50	15·50	—
Oxygen	22·00	8·85	13·15
Sulphur	1·60	—	1·60
Phosphorus	0·40	—	0·40
	100·00	33·20	66·80

From this tabular representation it is seen that in the presumed splitting up of the albuminous molecule one third passes into urea and two-thirds into complementary residue—that is, the relation between the urea and complementary residue is as 1 to 2. Now, some observations by Dr. Sydney Ringer on the relation between eliminated urea and sugar in diabetes that were published in the Medico-Chirurgical Transactions for 1860 present a conformity which is certainly striking, if nothing more. The observations show that during fasting and under a diet of animal food—when, in other words, there is no sugar from ingestion to influence the state of the urine—the eliminated urea and sugar stand in the ratio of 1 to 2·2. As might be expected, the figures representative of the eliminated products are much higher under the animal diet than during fasting, but, notwithstanding this difference, the same ratio was maintained. It is right to state that this correspondence I have brought into view must not be taken for more than it is worth, inasmuch as the complementary residue referred to does not express the composition of sugar or of one of the allied carbohydrates, the carbon being out of proportion to the hydrogen and oxygen, and particularly so to the latter.

Whatever may be the precise manner, however, in which the elements of nitrogenous matter become rearranged, it may be said that there are grounds, on the one hand, which have led observers to entertain the view that it is in the liver the production of urea occurs, and practically, on the other hand, it can, as I have mentioned, be shown that from nitrogenous matter amyloid substance is here formed. It is the latter point which essentially concerns us with reference to diabetes. The liver not only arrests the passage of sugar absorbed from the alimentary canal, and effects its transformation into amyloid substance, but also forms this substance from nitrogenous matter. This may be regarded as constituting the first step of an assimilative action exerted by the organ; and, if we are not able at present to follow the process on, and state what next occurs, we can, I consider, say upon the evidence I have advanced that the amyloid substance is not physiologically destined to undergo conversion into sugar, and pass as such into the general circulation. The glycogenic doctrine, it is true, implies the occurrence of such an event. Transformation into sugar is contended for, and Bernard speaks of this formation of sugar as the beginning of a series of phenomena of combustion ultimately resulting in carbonic acid and water.—*Lancet.*

DANGER FROM THE INJUDICIOUS USE OF ALCOHOL IN THE SICK ROOM.

Read before the Hartford County Society, May, 1878.

By T. D. CROTHERS, M. D., Superintendent of Walnut Hill, Hartford, Conn.

CLINICAL studies of the histories and early causes of many cases of inebriety indicate that the injudicious use of alcohol or its compounds, prescribed as a medicine, has been the starting point of many lamentable cases. There can be no doubt such cases are more frequent than we are aware of; also that irregular practitioners and domestic prescriptions are responsible for a large share of them.

A book on domestic medicine, quite popular a few years ago, and somewhat widely circulated, written by an irregular, in which alcohol was the common remedy recommended, has been the exciting cause in several well authenticated cases of inebriety, and has probably been the origin of many others.

The free use of bitters, containing alcohol in combination with very impure drugs, is responsible for a large per cent. of such cases.

Remedies that appear recommended in newspapers, with alcohol as a base, are also dangerous.

Medical men who have become enthusiastic as to the possibilities of alcohol have not unfrequently prescribed it for every condition of exhaustion for a long time. The results in many cases have been a possible transient good at the expense of propagating another disease more intractable and disastrous than the one they sought to relieve. The frequency of inebriety arising from such causes has brought out a special medical declaration in England, signed by most of the leading physicians and surgeons of the kingdom, calling attention to the belief that the inconsiderate prescription of large quantities of alcoholic liquids by medical men for their patients gave rise to intemperate habits, asserting that alcohol, in whatever form, should be prescribed with as much care as any powerful drug, and that the directions for its use should be so framed as not to be interpreted as a sanction for excess, or necessarily for the continuance of its use when the occasion is past. Bad results are not always clearly traceable, and do not follow in every case, or even in a progressive order, and hence are doubted.

As an illustration, an excellent physician said he could not, in his long experience of the use of alcohol as a medicine, recognize a single case of inebriety which followed from any alcoholic prescription that he had given. A few weeks after a case of inebriety was brought to me for consultation, in which the patient had taken by this physician's order brandy and cod-liver oil for eight months for incipient pulmonary hemorrhage. He recovered in part, but became an inebriate. The brandy with cod-liver oil was the first alcohol ever taken.

The disease of inebriety may be compared to malaria, which, having once pervaded the system, leaves a peculiar predisposition which only awaits a train of exciting causes to spring into activity.

Inherited conditions of organism may exist which give direction to weakened functional activities, exploding in inebriety with great certainty. The medical prescription of alcohol to such persons becomes the exciting cause, awakening and fixing conditions which may not break out at once, but sooner or later will be manifest.

It is a fact well established in medicine that certain not well-defined states of the bodily organism decidedly contraindicate the use of particular remedies. This is manifestly so in the use of alcohol in many cases, particularly when there exist in the history indications of neurosal degenerations, or decided inebriate tendencies, or conditions of functional disorder which are susceptible and likely to take on organic disease. Anæmia, neurasthenia, and neuralgia, and some conditions of rheumatism, also asthenic diseases, belong to this class, and are often developed into serious disease by alcohol.

Where alcohol is given medicinally any length of time the danger is greatly enhanced.

The following are presented as typical cases occurring in the practice of excellent physicians:

Rev. —— was the only son of a New York merchant, who became an inebriate at forty-five and died. His mother was an ambitious woman, always struggling into circles above her, and very nervous and impulsive. When a young girl she had St. Vitus' dance, and at the birth of her son had convulsions. She recovered, with an entailment of neuralgia, and various functional disorders. Her father was a hypochondriac for many years, and her brother, the uncle of the Rev. ——, drank more or less all his life.

It is evident from this that a marked neurosal diathesis existed, with a tendency to inebriety, depending on circumstances. Rev. ——, at twelve, developed a very sensitive nervous system, and at puberty suffered for six months from low nervous fever and general anæmia.

He was noted in his academical studies for his great mental capacity and irregular habits of work.

In college he secured several prizes, and was one of those good-natured boys who waste much time during the day and make it up at night. He drank soda and beer, and lived well.

During his studies at the seminary preparatory for the ministry dyspepsia came on, for which he used bitters, with some relief. At graduation he was in appearance slim, of light hair, with a strongly marked nervous diathesis.

His first charge, a Baptist church, brought him in contact with a people who gave rich dinners and lived high. His dyspepsia returned, and bitters were used with apparent good results. Two years later he married and was called to a city church, where the mental strain was continuous and severe. His habits of living were more or less irregular, and his dyspepsia came and went, although he continued to take medicine for this and various functional disorders. His pulpit work was impulsive and exhaustive. For weeks he would manifest great power and energy, then relapse into a condition of debility and indifference. After a revival season of much excitement he went away to the seashore for rest, and drank a bottle of porter a day, with great relish and apparent benefit. He returned to his work and continued drinking porter. His nervousness increased, and a low nervous fever followed, ending in general exhaustion and functional paralysis, from which he recovered very slowly.

The next two years were spent in retirement, and then he became pastor of a village church, and preached once a day. Five years later he had grown more nervous and neuralgic; any special excitement caused great prostration. He was often unable to continue his sermon from want of control of his nervous system. His mind seemed clear. He would work out in the garden for days, or go hunting or fishing, then remain in the house for an equal or greater length of time. He was very firmly opposed to the use of alcohol in any form, but continued to use different kinds of drugs, and sometimes bitters, with electricity, etc. Exhaustion, both mental and physical, with persistent neuralgia, became more and more prominent symptoms.

His church sent him to Europe for three months. While traveling on the Continent he drank wine freely, and came home much better. A year later his old prostration and nervousness came back with renewed energy. His family physician called a consultation, and, after a long examination of the case, recommended Bourbon whisky, with cinchona bark and other tonics. The relief was marked, and the effects very agreeable. Increasing doses were demanded, and soon he was intoxicated. Then he became passionately fond of whisky, using it in large quantities three or four times a day. A few months later he drank to intoxication, and from this time the progress of the case was rapid. He resigned his church, to avoid the publicity of drinking. Retiring to the country, he is to-day an inebriate, broken down, and drinking to intoxication with every opportunity. His mind is enfeebled, and full of delusions of self-control and ability to stop any time.

This patient inherited a tendency to nerve degeneration; his early habits indicated an alcoholic diathesis, or condition of exhaustion, which sought relief through the appetite. Mental labor and strain of all kinds reacted in this way. As he grew older this exhaustion became a sense of general agony and depression, and the organs seemed in sympathy with an undefined want, which alcohol, of all other substances, alone seemed to relieve. His visit to Europe, with a free indulgence of wine, fixed this tendency, which had grown gradually from year to year through the use of wine, and bitters, and other remedies. The untimely prescription by the physician precipitated his case, and, as it were, exploded a long train of diseased tendencies.

CASE 2.—John H., a farmer. His parents both died of consumption in middle life. His grandfather drank very hard after sixty years of age, and one of his uncles was considered insane. Two sisters died of consumption, and one brother suffered many years from rheumatism, and finally died of some intercurrent affection.

Nothing unusual happened in childhood, except a severe attack of scarlatina, from which he suffered two or more years, with a discharge and deafness. This passed away without entailment, and through early youth up to manhood he was in good health and apparently of robust mind and body. He worked on the farm from seventeen years of age, doing the usual work.

At twenty-four he married, and became owner and manager of a large farm. He was temperate in everything except eating.

At twenty-eight he was laid up in bed from a fractured femur, and suffered from a bed sore and low form of fever, for which he was given porter, and brandy, and eggs for many weeks. On recovery he showed a marked taste for beer, and continued its use regularly. This was continued for over a year, and was alternated with whisky, during which time he became intoxicated several times. From various causes he signed the pledge and reformed, although using cider occasionally.

At forty he began, abruptly, to use whisky, at a political meeting, and became intoxicated; he continued to use it for some weeks, and then stopped, as before. From this time he was nervous, and very excitable, and easily prostrated after any unusual event that interested him. He became a hypochondriac, and patronized quack and patent medicines for supposed heart disease.

At fifty he gave up his farm, and came to the city to live; he was nervous, and full of whims and notions, and impulsive in his way and manner, using cider and occasionally beer. The changed circumstances of city life, and want of healthy occupation, increased his nervous prostration and mental disquietude. Hypochondriac delusions came on, and a physician was called, who treated him for six months; then came a council of physicians, who agreed that a whisky punch and a bottle of porter a day would answer the indications best. A few weeks later he was intoxicated every night. No effort to stop was of any avail now. His mind sunk down to the level of an animal whose only ambition was its gratification, particularly in drink. He seemed maniacal if alcohol was withheld from him. The physician who prescribed for him pronounced it incipient dementia, and urged that he be under restraint. And a few months later he died in a state of coma from alcohol.

This case was also marked for the strong inherited tendency to drink, which was present in the consumptive and rheumatic diathesis present in the family. These diseases are frequently associated with inebriety, and noted as phases of this disorder.

Inebriety not unfrequently appears in the next generation in rheumatic or consumptive diathesis.

The first intimation of this diseased tendency was intemperate eating. After the fracture of his leg, and its consequent debility, a desire for beer and stronger alcohols was prominent, developing and fixing all previous latent tendencies. This he was able to control, until a few years later it burst out again with abruptness, and from this time out there was evidence of permanent alteration of disposition and intellect. The emotions and motor functions seemed to have changed, and when he came under care of the last physician the indications of an inebriate diathesis were clear. Nothing could be more fatal than the alcohol prescription.

These two cases appear to the general physician as simply, one, of nervous prostration and general exhaustion, the other, a hypochondriac, with disturbed intellect and emotions. Had a careful history of each been made, the contraindicative symptoms would have been apparent.

The general rule may be laid down that all cases of physical and mental exhaustion are extremely susceptible to the poisoning of alcohol, and liable to take on diseased conditions that are more or less permanent from its use.

2. From the best authority of clinical observers in this country and Europe, the use of alcohol in the sick room is attended with great danger, unless judiciously used.

3. The conditions contraindicating its use are numerous, and should be studied carefully where alcohol is thought to be of value.

4. The value of alcohol as a medicine is not assured beyond all question; the evidence upon which it has been given will not stand the test of analysis or accurate clinical observation, and we should always be well assured of the diagnosis of the case, and have strong evidence sustaining its use as a medicine in a given case.—*Med. and Surg. Reporter.*

THE Guinard prize of 10,000 francs has been awarded to Prof. Melsens, of Brussels, for his researches on the use of potassium iodide in combating saturnine and mercurial affections.

[Continued from SUPPLEMENT No. 140, page 2229.]

HISTOLOGY AND THE CELLULAR THEORY.

By DR. EDOUARD FOURNIÉ.

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from the *Gazette des Hopitaux*.

III.

THE ovule is an organ of life, destined like the other organs to fill a special function. The function of the ovule consists in assisting, after fecundation, the development of a complete organism, according to a plan that varies with the species. In a completely developed organism the matter is disposed in such a manner that it may fill three kinds of functions: nutrition, relation, and reproduction. These functions are performed by special organs, themselves composed of histological elements. Now, as the organs are the definite result of histological elements, and as, consequently, the function may only be partly the result of the peculiar properties of the elements, M. Virchow, and with him all histologists, have concluded that the histological element, the cell, fills a *function*. This was a deplorable error, for it is on that, as we shall see further on, that the most of the false doctrines that are now current in our books depend. We, for our part, say that *the cell lives, but does not perform any function.*

The cell enters into the composition of the human body for the same reason that various elements of matter together form the structure of an edifice. In the one case, and in the other, the elements carry in the assemblage of their peculiar properties, but we should not say that on this account they perform a function.

The ashlar, by the dimensions of its extent, which are one of its properties, helps to form a house, a shelter; but taken alone, it would not fill the function of the house, which is to shelter. The molecule of glass, of which the essential property is its transparency, would not, taken alone, fill the function that we demand of it. In the same way the cells of the living body, taken singly, may indeed manifest certain *special properties;* but, in any case, we are not authorized to say that they *functionate.*

The cells together help the divers functions of nutrition; but, by themselves, in their isolation, they cannot fill any of these functions; on the contrary, it is these very functions of nutrition that prepare for them the fluid in which exist the conditions for their sustenance, and which enable them to maintain their special properties.

The cells together assist, by their properties, the functions of relation; but, by themselves, could not establish any other relation than that which is imposed upon them by the *plan of organization.* It is incontestable that the total contraction of a muscle is only the resultant of the individual contractions of its fiber-cells; but we would not attribute to the fiber-cell the *function* of the muscle; the fiber-cell, under the influence of the functional excitant, furnishes its *contractile properties,* and the muscle really accomplishes the *function,* varied according to its attachments. A fiber-cell cannot supply the place of a muscle in a functional point of view.

The cells, finally, by their properties together perform the functions of reproduction, but any one of them would not fill the formative function of the ovule. During the embryonic period, it is true, the cells seem endowed with a reproductive power; but that power which they hold by reason of the special properties of the ovule is, definitely, temporary, and should be considered as one of the kinds of formative impulse during the period of development. Later on, when under a morbid influence this power seems to reawake, it gives rise to unforeseen forms, which constitute the pathological state.

We see clearly, from what precedes, that, fatally connected to the plan of organization that held sway at their birth, the organic cells borrow from the function of nutrition the conditions of their sustenance, and of the maintenance of their special properties. We see equally well that their *vital manifestations* reduce themselves to two: 1st, to keep themselves in the state of living organic elements, thanks to the functional movements of life; 2d, to furnish to these very functional movements the assemblage of their *special properties.* There is nothing in these manifestations that resembles a *function;* consequently we were right in saying that cells live, but do not perform functions. Meanwhile does an organic material which lives without functionating deserve that we should accord to it the attributes of individuality? No, certainly not. For unless we change the signification of all words, the animal, the plant, are only individuals by virtue of the assemblage of functions that they fill, whether it be on account of their sustenance and their reproduction, or their relation with the medium in which they live.

This is what we shall now see, in another way, in analyzing the vital manifestations of the animal.

We will take, for example, among the unicellular animals, a rhizopod, a gregarine.

Gregarines live parasitically in and around the ventral cavity, and are unprovided with a mouth or digestive canal. Immediately after its issue from the mother cell, the young gregarine moves in every sense in the medium, immense for it, where it was born. Now, there is no movement without contraction, and, from the moment that the gregarine contracts to move itself, we say that it *functionates.* In this act, indeed, it does not furnish, like the fiber-cell, its special properties to a muscle which itself fulfills the function; the gregarine is all at the same time both muscle and cell, since it contracts itself in the beginning to change the relations of its body with the external world; it fills, then, a function in moving.

The organic cell, plunged immediately into the midst of life, maintains the state of a living element; but, in that fact, it does not functionate: it elaborates according to its capacities the living elements that bring to it the blood. The gregarine, on the contrary, deprived of all direct connection with life, is obliged to borrow from the medium that incloses it the elements for its nutrition, to transform them into living elements, and, though it has no digestive tube, we say that it functionates because it assimilates to its own proper substance non-living elements in the *essential aim* of self-nourishment.

Finally, when the gregarine has attained the limits of its existence, we see it fix itself at a point in its medium; then it transforms itself into a gelatinous mass (psorosperm), which does not delay in inclosing itself in a membrane.

In the interior of this membrane a cell develops, in that a nucleus, and, finally, this latter escapes in the state of an *amœba* after the rupture of the external membrane. Some time after, the amœba has become a gregarine. We call this series of evolutions the *function of reproduction,* and there is no necessity to further verify this qualification. The ovule is the only globular body that presents analogous phenomena; but the ovule is an organ charged with a function, and cannot be likened, as authors on the cellular theory have done, to any cell of the organism.

It is shown from this example, chosen from among the least favorable, that the vital manifestations of *animals* are fundamentally different from those of *living anatomical elements,* and particularly of *cells.* These last, indeed, live and furnish, when occasion demands, their special properties to functions; the first live and perform functions. It is by these functions, varied according to the species, that the animal shows its individuality among other beings. It is not then allowable to liken, as M. Virchow has done, living cells to *individuals* such as the plant and animal.

It will be remarked, perhaps, that we have taken particular pains to refute an opinion apparently accessory to the formula *omnis cellula a cellula.* It is because this opinion is of great importance, in spite of the facility with which M. Virchow sets it forth. From the moment, indeed, that we can liken the organic cell to an animal or to a vegetable, it follows that the cells arise by generation from other cells, and that the cellular element could not be produced in any other manner; it follows, further, that the cells which constitute certain pathological products are the children of physiological cells, and it is precisely thereupon that the whole physiological and pathological doctrine of M. Virchow rests.

The subject, then, has deserved all our attention: *principiis obsta.* But the development that we have given to our argument had another aim. We wished to apply the principles of general physiology that we have set forth above; we wished to show that they are indispensable to the elucidation of every physiological problem; we wished to prove finally that these principles make the author of the cellular pathology completely in the wrong. M. Virchow, indeed, in according functions to cells, distorts the meaning of the word *function;* he spreads the most deplorable confusion, and he impresses on the progress of physiology a *retrogressive* impulse.

In what precedes we have proved that M. Virchow was not authorized in comparing the cell to the animal, and that, consequently, he ought to renounce finding in that comparison a favorable argument to his theory. It remains to find out if the fact of the production of cells one from another is true, and if the cell is the ultimate morphological element in which life manifests itself.

Here again M. Virchow sets out from an analogy absolutely false, and, moreover, the very fact of the origin of cells is erroneous in what he says is positive. Let us at once see to the first point.

First Point.—With Schwann and many others, M. Virchow establishes a complete analogy between the ovule and cells in general, and, thence, by considering still further that up to a certain period of its development the embryo is entirely composed of cells, he concludes, with a show of reason, that every cell comes from another cell. The morphological characters of the egg and of cells argue somewhat slightly in favor of that analogy, but we are not authorized to resolve physiological problems by the methods of geometry. Moreover, the beautiful researches of M. Balbiani on the ovule will no longer allow, even looking at the anatomical constitution, of likening the ovule to any cell whatever. Which is the cell that at once incloses a nucleus and an embryogenic vesicle? Any? Which, again, is the cell that presents, like the ovule, an enveloping membrane of cuticular formation? Any?

As we said previously, it is chiefly by the examination of vital manifestations that we discover the special characters of living organized matter. Now, the examination of these manifestations is directly opposed to our establishing the least analogy between cells and the ovarian globule. The first are *anatomical elements* rejoicing in certain peculiar properties; the second is an organ filling, after fecundation, a *special function.* To form the living body, such is the function of the fecundated ovule.

Some hours after the arrival of the spermatozoids on the vitelline sphere, the function of the ovule manifests itself by the appearance, in its center, of the vitelline nucleus, then by the formation of the spheres of segmentation, and the complete transformation of the vitellus into blastodermic cells, and finally by the disposition of these last into membranes or blastodermic layers.

The formation of the cells and of the blastodermic layers is the first expression of the functional power of the ovule, and it is only necessary to see, in this division of the vitelline substance, a process of multiplication, which should end in a division of the physiological work. The ovule does not cease to exist as an organ, but its elements having received a distinct form by the segmentation represent so many *functional elements* which may assist one another, each in a special manner, in the formation of the complete being. This is how we see the successive appearance of various organic systems which, for the most part, have a well determined blastodermic origin.

While the embryo is developing, the ovule augments in capacity; its envelope formed, successively, by the vitelline membrane, by the amnion and by the allantois, sunk by deep roots into the uterus; and finally, when it has reached the end of its development, that is to say having acquired a volume thirty thousand times greater, the rupture of the membranes allows it to throw off its contents, which is the living being.

By good logic, those who have compared the ovule to any cell whatever should follow step by step the development of the ovule, and they are thus conducted to consider the egg at term to be like a cell of which the *chorion* and the *amnion* will form the envelope, the amniotic liquid the contents, and the fœtus the nucleus. It is thus that the living being, on coming into the world, will represent the nucleus expelled from a cell! A very droll conclusion, truly, and which shows the random method of the framers of plausible hypotheses that scientific severity disapproves of.

Some vital manifestations, similar to those we have just enumerated, we only find in unicellular living *beings,* that is to say in organized matters that are provided with functions; the cells of the organism, representing *living elements* and endowed with *peculiar properties,* have no *functions.* Certain cells of the organism may, it is true, multiply by segmentation or any other process, but any one of them does not constitute an organic whole, composed of essentially distinct parts, developing in proportion to the development of its contents, and possessing a function which ends, not in the reproduction of a cell, but in the formation of a living being. Cells obey the law of multiplication of matter by being segmented; but, in doing that, they simply *live* without fulfilling *functions.*

The ovule is itself an organ destined to fulfill a function, and it is in view of this latter that its matter becomes segmented in various ways, but always remaining under the same envelope. We should not, then, liken cells to the ovule, the former of a living being.

To fulfill its function, the ovule avails itself of the cellular form, favorable to the multiplication of its functional power; but, on this account, the cells produced by the segmentation of the vitellus are, like other cells, *simple functional elements* endowed with peculiar properties. A blastodermic cell, indeed, taken alone by itself, would not fill the function of the ovule, and for a much stronger reason it could not be likened to that organ, for from a physiological standpoint we cannot liken the whole to a part.

It results from the preceding, that neither looking at the anatomical constitution, nor from the standpoint of vital manifestations, are we authorized to liken cells in general to the ovule, the former of the living being. The first are functional elements; the second is a complete organ destined to fulfill a function.

(To be Continued.)

[Continued from SUPPLEMENT No. 130, page 2205.]

THE ART OF PRESERVING THE EYE-SIGHT.

Adapted from the French of ARTHUR CHEVALIER.

IX.—OF COLORED GLASSES AND THEIR USES.

IN relation to colored glasses we would say that the best tints are *blackish blue* and *neutral tint,* which are to be used according to circumstances that will be indicated further on.

Pure green and blue tints should be totally banished; the green tint is mingled with yellow, and gives a greenish and reddish shade to all objects; the blue tint is mingled with red, and renders everything that we look at bluish or yellowish. On placing a blue glass before the eye, objects will appear yellow when it is removed; if the same experiment be tried with a green glass, the objects will appear red. Or, in other words, the eye will perceive the *complementary color* of the glass used. It may be readily understood, then, why these glasses should be rejected.

FIG. 71.—COMPOUND SPECTACLES.

The adoption of the tints that we have recommended is due to the researches of the Abbé Rochon, De Vincent, and Charles Chevalier—the object of these researches being to find a shade which should weaken the color of objects without changing their tint; and what more rational? How could we hope to improve the sight with glasses which change the color of objects, and consequently injure the retina? Some have extolled the virtues of blue glass by saying that this color destroys the yellow rays. But where do we find these yellow rays? During the daytime colored rays are but slightly diffused; during the evening our lights give us yellow, orange and red; how are we to combat this with complementary tints? As we have already seen, the tint which weakens the light without changing the color of objects is best, and there are no difficulties in the way of obtaining it.

Again, in certain works very singular advice is given, bluish and greenish glass being recommended. This is an error that should be guarded against when tinted glass is prescribed. A good way to test the tint of glasses, in order to see whether they contain any red, is to incline them in such a manner that one of the surfaces reflects the light; if a violet blue tint is seen, it at once shows the defect that we speak of.

There are two prominent troubles with colored glasses as at present manufactured, one of them arising from impurity of materials used, and the other from the multiplicity of tints It must be confessed that we find thousands of variations in color, which naturally give rise to great confusion. Why does this happen? For this reason: tinted glasses are all made of common window glass, more or less coarsely colored. Certain manufactories, from time to time, make glass of this kind, and opticians are obliged to put up with such coarse material in making their colored lenses. Scientific glass manufacturers should produce an article of very pure colored crown glass, but up to the present time they have not chosen to do so.

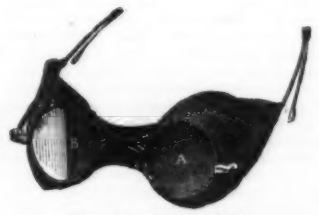


FIG. 72.—GOGGLES.

In glass making a smoky color is obtained by mixing oxide of iron, copper and cobalt with the material. For making blue glass oxide of cobalt is used, and for violet, oxide of manganese; green glass is obtained with sesquioxide of chromium and salts of uranium; yellow glass, with oxysulphuret of antimony; orange-yellow, with silver.

The use of colored glasses is very necessary in certain cases; in countries covered with snow, for instance, it is impossible to dispense with them. In addition to such particular cases, they are useful for eyes sensitive to light (*photophobia*), also in *choroiditis*, in *iritis*, after the operation for cataract, and in a multitude of other affections. Only it is very necessary to observe that, while in some cases they are useful, they may nevertheless injure the sight if used without due consideration. In myopy they are almost always indispensable, and generally it will be well to have colored glasses both for day and night use. The latter will necessarily be of a lighter tint. Like M. Desmarres, we believe they are injurious in presbyopy. Colored glasses of a pale tint are also useful in certain professions, where light is reflected from polished and shining objects; they are always indispensable to glass-workers, founders, etc.

Charles Chevalier points out some excellent precautions that should be observed in using colored glasses. He says:

"Whatever be the kind of colored glass made use of, the eyes must always be closed at the moment of removing the spectacles, because the organ always experiences a very painful sensation when it is exposed too suddenly to a transition from a mild to a dazzling light. This observation may also be applied to ordinary spectacles."

We have said that only two tints must be used—blackish blue and neutral. Necessarily different shades of these tints are to be employed: thus, *dark, medium, light* and *extra light* shades. To protect the eyes from the glare of the sun, dark or medium neutral tint should be prescribed; but when it becomes a question of reducing the light during muggy weather, or in a country where sunshine is rare, then a blackish blue tint of medium or light shades must be recommended. In certain cases great advantages will be derived from the use of blackish blue glasses of light tints. These are especially recommended to myopes, and in all those cases where colored glasses are useful for near objects. Colored glasses, as found in commerce, may be classified, in proportion to the light they absorb, as follows:

Pure Blue,
Blackish Blue,
Smoky,
Blackish Green,
Green,
Blackish Yellow

Blue absorbs light less, but it gives a complementary color; green does the same; blackish green and yellow are injurious. There remain, then, blackish blue and the smoky tint, as we have before remarked.

FIG. 73.—GOGGLES.

Colored glasses are made plane, concave or convex, but it is sometimes necessary to combine the beneficial action of colored glasses with the power of colorless convex or concave lenses; in this case supplementary frames containing colored glass are hinged to the ordinary spectacles. These frames rest against the temples, and prevent the admission of lateral rays. In order to obtain the combined effect of the colored tint and the magnifying power of the lenses it is only necessary to turn the supplementary frame down over the lenses of the spectacles. Usually the frames are made in the shape of a horseshoe, and this indeed is the best form for these spectacles (Fig. 71); but they have the disadvantage of being heavy, and when they are not actually necessary it is generally preferable to unite, in a single and same lens, the proper shape and tint, either by using colored glass alone or in soldering the colored glass to the white. The latter method has this advantage, that we thereby avoid a too dark and unequal coloring of lenses with short curves. If the lateral light fatigues the eyes, shields made of double black crape may easily be added (Fig. 72). We will speak of goggles (Fig. 73) here, only to point out that *they are injurious.* The form of these glasses necessarily prevents them from having a perfect parallelism, unless they are used with

FIG. 74.—RAILROAD SPECTACLES.

infinite care. Moreover, almost all the lenses of goggles are made of blown glass. On turning a goggle-glass around in a circular direction before the eyes, objects seen through them appeared deformed. We have seen persons who wore such spectacles unable to direct themselves. For our own part we consider goggles true instruments of torture. The glasses called railroad spectacles (Fig. 74) can be recommended, and will be found useful for protection against sunlight, wind and dust. The best way to use colored glasses is to mount them in large circular frames; in this manner they give perfect relief to the eyes. In conclusion, we will speak of the eye-shade. The shade of our ancestors would not be a bad thing if it did not compress the temples, and if it did not heat the eyes too much. It has the disadvantage, moreover, of being extremely ugly in appearance. However, in certain cases it can be recommended, for it may do considerable service.

IODINE IN PACIFIC SEA WEEDS.

W. B. JONES, of the University of California, has been analyzing a variety of sea weed (Laminaria) common on the Pacific coast, and finds it exceptionally rich in iodine. The weed grows in great abundance on the shelving rocks at low-tide mark, some of the plants reaching the length of five feet. Mr. Jones finds 15 per cent. of ash in the dried plant, the analysis of which discovers—

Iron	traces
Aluminum	0·093
Calcium	9·870
Magnesium	5·320
Silica	1·210
Sodium	8·11
Potassium	15·580
Iodine	0·99534
Sulphuric acid	26·2750
Phosphoric acid	3·2400
Carbonic acid	16·67
Chlorine	5·7
Bromine	traces
Total	93·06334
Loss	6·93666
Total	100·00000

Comparing the amount of iodine found in this analysis with that found in similar analyses of the dry plants of other species, he finds that this species contains over twice as much iodine as any of the plants from which iodine is manufactured.

	Sarphati.	Stanford.
Fucus filum	0·0894	
Laminaria digitata	0·1350	0·4788
Laminaria saccharina	0·2300	0·1583
		Jones.
Laminaria Andersonii		0·99534

The method of iodine manufacture is quite simple, no complicated machinery or apparatus being necessary. It seems evident that if it can be profitably produced from kelp containing only 0·1350 per cent. and 0·4788 per cent., it could certainly be manufactured with a profit from a kelp containing almost 1 per cent.

According to Mr. Stanford's method of preparing kelp, one sample of *Laminaria digitata* produced 33 pounds of iodine per 20 cwt. of kelp. Accordingly *Laminaria Andersonii* ought to produce at least 60 pounds per ton of kelp. The ash, moreover, is very clean and free from silica, whereas in most of the other species which have been used in iodine manufacture the silica varies from 2 per cent. to 11 per cent. The weed grows abundantly, and during the season each cutter could easily gather at least a ton per day.

"CHEMICAL NEWS" NOTICES.

Influence of Electricity upon Vegetation.—M. Berthelot.—Referring to M. Grandeau's paper "On the Influence of Atmospheric Electricity upon the Nutrition of Plants" (*Comptes Rendus*, lxxxvii., No. 2), the author recalls the analogy of the result with his own experiments on the formation of nitrogenous matters under the influence of atmospheric electricity. Hitherto in agricultural chemistry there has been understood under the name of atmospheric electricity merely the formation of nitric and nitrous acids and their ammoniacal salts, produced by the passage of lightning, without having any idea of the direct reactions which may come into play between plants and the atmosphere. Yet these latter seem to me the more important, the smallness of the effects being compensated by their duration and by the extent of the surfaces influenced.

Electro-metallurgy of Cobalt.—A. Gaiffe.—The author has been struck with the beauty of cobalt galvanically deposited as well as by its hardness. It is not oxidized like iron, and much less care is required to keep its surface in good condition. Its beautiful white color will make it suitable for the decoration of other metals. The bath used was a neutral solution of the double sulphate of ammonia and cobalt, which does not require nearly so much care as the nickel baths. The anode may be a sheet of platinum, or better a plate of cobalt, either cast or forged. To obtain a white and adhesive deposit the current ought to be regulated at the outset, at 6 units of electro-motor force of the standard of the British Association, and be brought to 3 units only when the entire surface of the article to be coated has become white.

Russian Chemical Society.—M. Setschinoff announces that in studying the action of carbonic acid upon albumen he finds that upon heating ordinary white of egg in a vacuum at 30° to 35° it gradually assumes a gelatinous texture, and is transformed into very hard fibrous flocks, having a great resemblance to the flocks of blood fibrin.

M. Mendeleef, on behalf of E. Schœne, described the action of hydrogen peroxide upon the oxy-compounds of thallium. Whether in solution or in the gaseous state it converts thallous oxide into a brown oxide insoluble in water. The brown coloration of ozonoscopic paper impregnated with thallium cannot, therefore, serve as proof of the presence of ozone in the atmosphere in which the author has previously demonstrated the presence of hydric peroxide.

Liquid Camphor.—M. Wreden announces that he has converted ordinary camphor into a liquid isomer by the action of dilute hydrochloric acid at 190°. The new compound boils at 187° to 193°. Its sp. gr. = 0·913, and it does not crystallize at a temperature of —17°.

Potassium.—Dr. Erckmann.—As a lecture experiment the author introduces a piece of potassium, of the size of a pea, into a small test-tube, heats to fusion, turns the glass round and round till the metal congeals, and then seals up the tube. The greater part of the potassium is deposited on the sides of the tube as a specular metallic coating, resembling silver, and can be exhibited during lectures, etc. The other alkaline metals may be similarly treated.

IT is reported from Munich that a case of arsenical poisoning has occurred in a man who has been suffering from a disease of the eyes, and who has for a long time worn a green silk screen over his face.

Water-Examination and Water-Pollution.—Dr. H. Vohl, Dr. F. Fischer and J. P. Dahlem.—Dr. Vohl has examined the waters of the Rhine, between Cologne and Mühlheim, with particular reference to the putrid matters introduced by cesspools, privies, domestic and industrial residues. As the material for his investigations, he selected the incrustations and residual waters from the boilers of steamboats, which ply upon certain parts of the river only, choosing those only where no compositions are used to prevent deposits. In the incrustations, the presence of arsenic was distinctly recognized, derived doubtless from the waste waters of dye and color works. The tests applied for other poisonous metallic oxides, such as copper, lead and zinc, gave negative results. A not inconsiderable amount of phosphoric acid owes its presence, according to Dr. Vohl, to the influx of excrementitious liquids. The existence of fatty acids in the concretions proves the contamination of the water with soap-lyes. In the concentrated residual waters were found considerable quantities of chlorine and nitrites, a proof that the river receives large quantities of animal refuse. The presence of sulphureted hydrogen indicates, with great probability, the presence of sulphites and hyposulphites, whose origin is still dubious. Dahlem rejects all the methods hitherto in use for testing the purity of drinking water, such as Fleck's silver-solution, permanganate, microscopic examination, etc., and declares that all depends here on the reply to the chemico-biological question: "Is the organic matter present in water of such a kind that it can serve as nutriment for the low organisms belonging to the family of moulds?" As these organisms have the property of flourishing better upon congealed albuminoids than upon such as are still in solution, and can do this upon materials coated or saturated with such compounds, the author selected for his experiments in this direction the production of films by means of a solution of tannin at 5 per cent. Of this, he pours 5 c.c. into 100 c.c. of the water under examination, and finds that in all waters where a turbidity arose, whether sooner or later, mould appeared, forming a thick crust, while in the opposite case, under perfectly similar circumstances—a temperature of 12° to 15° (C. or R.?)—no mould appeared even on standing for weeks.

Uses of the Earth Worm.—V. Hensen.—The author maintains that soils considered barren are made fit for vegetation by the twofold activity of the worms, which open passages for the roots and line these passages with humus. In sandy soils the burrows of the earth-worm extend almost vertically to a depth of 3, 4, or even 6 feet, and are sometimes carried horizontally at the bottom. These passages are coated inwardly with the black excrements of the worm. Old worm burrows are occupied by the roots of the plants growing on the surface, which send out capillary rootlets to the walls of the burrow. The question whether all the roots of plants found growing in the subsoil have originally penetrated down worm burrows cannot be decided with certainty. A microscopic examination of the masses deposited by earth-worms shows that they resemble the well-rotted leaf-mould used by gardeners in potting plants; most of the vegetable cells are destroyed through single cells, and fragments of tissues remain, mixed with many sand-granules. The statement that the earth-worm gnaws the roots of plants is, according to the author, totally unsupported by facts. The intestines of the worm never contain parts of recent plants.

Nitrogen in Peaty Soils.—Prof. H. Ritthausen.—The author has repeatedly found in peat, peat soils and humiferous marls quantities of nitrogen higher than occur in ordinary soils. In consequence of similar observations, peat has been recommended as a manure. In a sample of peat dried at 100°, the author found 3·22 per cent. of nitrogen. It appears that humus and similar bodies retain ammonia energetically, forming sparingly soluble nitrogenous bodies, which partly consist of ammonia-humates of lime and magnesia.

Seeds from High Latitudes.—Prof. A. Petermann.—The author concludes that the seeds of Timothy grass, clover, pine and fir, gathered in Sweden, between latitudes 55·20° and 60·40°, are distinguished from those grown in more southern lands by their higher germinating power, which is shown not merely by the large number of fruitful seeds, but also by the energy of the process of germination; by their cleanness, and by their great average absolute weight. These results are in accordance with the principle of natural selection.

Gypsum in Water used for Brewing.—L. Geisler, C. Frank and O. Schottler.—The yield of extract from the malt is considerably diminished by the presence of gypsum in the water, though amount of proteinoids in the wort is not affected. The proportion of phosphoric acid in the wort is reduced by nearly half, and the ash undergoes no increase proportionate to the quantity of gypsum.

Composition of Ancient Glass and Crystal.—By E. Peligot (*Ann. Chim. Phys.*).—It is generally stated that the glass manufactured by the ancients was prepared from the same materials as are used at the present time. Such is not, however, the author's opinion; common glass and lead crystal had formerly a composition very different from that of more recent date. Three ingredients are now employed in the manufacture of glass, namely, silica, soda, and lime. Bohemian glass has potash substituted for the soda. But with antique glass only two substances were employed, sand and an alkaline flux. Many old recipes are given, but no mention is made of lime; this substance, however, is generally present, and was probably introduced accidentally with the flux or the sand. Analyses of various selected specimens of ancient glass, chiefly from Autun, of about the 11th century, gave: Silica, 66·0—70·9; lime, 5·8—7·9; alumina, oxides of iron, and manganese, 2·8—5·7; soda and potash, 16·7—24·7. The presence of soda together with potash indicates that the ash of seaweed was used as a flux. Lime has only recently been employed in the manufacture of glass. Window glass analyzed by Dumas 35 years ago contained only 3·8 per cent. of lime. Water and chemical reagents have considerable action upon ancient glass. A well made glass at the present time contains 12—15 per cent. of lime; the alkalies are contained in almost equivalent proportions. These data furnish a ready method for distinguishing modern from ancient glass.

Lead Crystal.—Very old specimens of glass are found to contain lead, but the author does not regard them as real crystal. This material is of modern manufacture, introduced by the English, under the name of "flint glass."

Flame Reaction of Boric Acid.—By H. Gilm (*Deut. Chem.*).—A regularly tinted and beautiful green boric acid flame is best obtained by passing the vapor of boric ether through a kind of Bunsen burner, made by inclosing a small, narrow glass tube in a vertical one, so that the gas may mix with air previous to ignition at the upper end of the tube. The same result is obtained by allowing the vapor of the ether to pass through an ordinary Bunsen burner, the tube of which is heated to avoid condensation. For qualitative analysis it is most convenient to use a small flask, provided with a cork, through which passes a short, drawn out glass jet, a wider tube being placed over the latter, and the gas ignited at the top. After the addition of hydrochloric acid, very small quantities of boric acid may be detected by this means.

Precipitation by Phosphorus.—By R. Böttger (*Chem. Centr.*).—Pure phosphorus precipitates gold, copper, and palladium from solutions of the salts of these metals; silver is thrown down as phosphide, while platinum, uranium, nickel, iron, zinc, cadmium, and cobalt are not precipitated by phosphorus.

Suspension, Solution, and Chemical Combination.—By W. Durham (*Chem. News*).—Some time ago the author made some experiments on suspension of clay in water, in acid, and in saline solutions, which led him to experiment on various solutions, the results being very interesting, and promising to open up a line of research likely to lead to important facts as to the laws of solution and chemical affinity. The following conclusions may be drawn from the experiments undertaken:

1. There seems to be a regular gradation of chemical attraction, from that exhibited in the suspension of clay in water up to that exhibited in the attraction of sulphuric acid for water, which we call chemical affinity.

2. That chemical combinations, solutions, and suspension differ only in one degree, and are manifestations of the same force, and definite chemical compounds are just the points where the affinity exerts force enough to hold an exact number of atoms with a certain strength.

3. The attraction of chemical affinity is not, in every case at least, exhausted when a definite compound is formed, but has sufficient power left to form solution or suspension compounds.

4. If chemical combination and solution are due to the same force, then solution will loosen the combination by spreading the affinity, and possibly there may be a rearrangement of the soluble matter and the solvent, analogous to what is known to take place when two salts having different acids and bases are mixed.

If these views prove to be correct, the author believes them to be able to explain many phenomena at present obscure.

Anærobiosis of Micro-organisms. — M. Gunning. — The author has previously recommended ferrous ferrocyanide as an extremely sensitive reagent for oxygen, and has by this means shown that the apparatus and media in general use for the culture of micro-organisms cannot be freed from oxygen by the methods usually recommended for this purpose. These observations throw a legitimate doubt upon the experiments serving as the basis of the doctrine of anærobiosis, and he has therefore repeated these experiments with the necessary precautions. He has made use of glass vessels sealed at the lamp, in which the largest possible quantities of putrescible matter were placed in contact with minimal quantities of oxygen. Urine, blood, meat-broth, yeast-water, etc., in a recent state were infected with bacteria taken from similar substances in full putrefaction. The vessels were then sealed and exposed to a temperature of 38° to 40°. Putrefaction was at once set up, but was definitely arrested in every case after a longer or shorter time—often very short—but always sensibly proportionate to the quantity of oxygen supposed to be present. The author attributes the cessation of putrefaction solely to the death of the bacteria caused by the absence of free oxygen. If the vessels containing putrescible matters terminate on one side in tubes fitted with a plug of wadding or coiled round several times, the point being drawn out to a fine point and sealed at the lamp, we may, at any desired moment, by breaking the point, expose anew the putrescible matters to the contact of atmospheric air, deprived, however, of germs. If the substances have been allowed to reach the state of complete inertia, air no longer produces the least phenomenon of putrefaction, or of appreciable alteration. Blood, however, forms an exception, as it undergoes an alteration similar to that described by Pasteur in his "Etudes sur la Bière," p. 49, effected without the aid of organisms. This experiment seems to prove not merely that the bacteria as well as their germs are dead, but that the organic matters are not capable of spontaneously producing others. These experiments furnish the most conclusive proofs against spontaneous generation.

Differences of the Affinities of Chlorine, Bromine and Iodine. —M. Kühlmann.—The author measures the quantities of heat evolved in the reaction $M+R+xHO$. M is a metal, R may be chlorine, bromine or iodine, and x a very high number. He shows that if bromine and iodine are substituted for chlorine in aqueous solutions of hydracids or of haloid salts the differences of affinities as measured by the quantities of heat liberated are multiples of the number 5·350. The ratio of the differences of the affinities of chlorine to bromine or of chlorine to iodine is 2 to 5. This number recurs, though less distinctly, in other reactions. It is the simple proportion of $\frac{1}{3}$ and $\frac{2}{3}$ with the numbers 18·725 and 13·375, which, according to Thomsen, are often met with in analogous experiments.—*Poggendorff's Annalen.*

Researches upon Fluorescence.—M. Brauner.—Solar rays are caused to fall upon two rectangular prisms of crown glass cemented together by their hypothenuse surfaces; on turning this system all the refrangible rays may be eliminated, *e. g.*, as far as D. This light is concentrated by a lens upon the substance to be examined, and it is viewed through a system of two rectangular prisms of flint glass, cemented together by their hypothenuses, between which essential oil of cassia has been placed. The rotation of this system causes all the red rays to disappear, for instance, as far as D. White paper thus observed appears dark, but eosin and naphthalin red appear green, which confirms the results of Lommel. This arrangement of prisms gives more light than the ordinary spectroscope.—*Wiener Anzeiger.*

Ethoxyacetonitrile.—T. H. Norton and J. Tcherniak.—This compound is a colorless, very mobile liquid, of a peculiar but agreeable odor and burning taste. It is sparingly soluble in water, but miscible with alcohol and ether in all proportions. It boils at 132° to 133° under a pressure of 758·5 m.m. Its sp. gr. at 20° — 0·9093. Alcoholic potassa decomposes it at the boiling point with disengagement of ammonia.

Influence of Atmospheric Electricity upon the Nutrition of Plants.—L. Grandeau.—The author, after a carefully conducted series of experiments, concludes that atmospheric electricity is a preponderating factor in the assimilative process in plants. Plants withdrawn from this influence by means of a "Faraday cage" elaborate in equal times, all other conditions being equal, from 50 to 60 per cent. less of living matter than those whose growth has been effected in ordinary circumstances. Plants little raised above the soil are equally affected by atmospheric electricity. The percentage of proteic matter formed does not appear to depend on the action of atmospheric electricity, but remains proportional to the total crop. The percentage of ash is higher in plants protected from electric action, but the proportion of water is higher.

Structure of Several Minerals.—M. Gaudin.—The author proposes to submit to the Académie several studies which he has made on various minerals, throwing an important light upon their composition, their intimate crystalline form, and rendering it possible to calculate—often with absolute precision—their principal angles, taking for the distance of the molecules from each other in a horizontal direction (lateral assemblage), or in a vertical direction (superposition), the atomic distance, $\sqrt{2}$ atomic distance, the double or triple atomic distance—in a word, the atomic distance multiplied by a very simple number increasing with the diameter of the molecules.

Para-chlor-benzyl chloride and its Derivatives.—C. Loring Jackson and A. W Field.—Para-chlor-benzyl-chloride is no liquid, but forms white shining needles or prisms of a pleasant aromatic odor, and having a violent action upon the mucous membranes. Melting point, 29°; very volatile; sublimes at common temperatures. Insoluble in water, sparingly soluble in cold alcohol, though readily in hot; very soluble in ether, benzol, sulphide of carbon, and glacial acetic acid. If boiled with water it yields para-chlor-benzyl-alcohol and hydrochloric acid.

Difference of Absorption Spectra of the Same Substance.—Hermann W. Vogel.—In the author's memoir (*Berichte*, vi., p. 632) he has shown by several examples that under different circumstances one and the same body may give absorption spectra of totally different characters. Further investigations on this subject have shown that this peculiarity is an almost universal property of all absorbent solid and liquid bodies, whether organic or inorganic; those substances which in the solid state give the same spectrum as in solution belonging to the exceptions. Hitherto the absorption spectrum of a salt or of a coloring matter has been supposed to signify the spectrum of its solution, assuming, often without further question, that it must be identical with that of the solid body, though examples to the contrary were not unknown. This assumption can now be no longer maintained. For examining the spectra of solid salts and coloring matters the author employs thin strata obtained by evaporating a solution of the substance upon glass plates or in watch glasses. The results obtained could not be intelligibly described without the numerous diagrams of the original memoir.

THE DISTRIBUTION OF AMMONIA.*

By DR. R. ANGUS SMITH, F. R. S., &c.

IF organic matter is everywhere, ammonia is everywhere possible, and if that matter is decomposing, ammonia is everywhere. This is the general statement which this paper illustrates. It is now many years since it was observed by me that organic matter could be found on surfaces exposed to exhalations from human beings; but it is not till now that the full significance of the fact has shone on me, and the practical results that may be drawn from it in hygiene and meteorology. These results are the great extension of the idea that ammonia may be an index of decayed matter; the idea itself has been used partly and to a large extent, as illustrated in my "Air and Rain." The facts now to be given enable us to claim for it a still more important place. The application seems to fit well the conditions already examined, and by this means current from foul places have been readily found. This does not apply to the substances which may be called germs, whether it be possible to see them or not, because these are not bodies which have passed into the ammoniacal stage, although some of them may be passing; those, for example, which are purely chemical and exert what we may call *idiolytic* action. This word may serve to mark this peculiar action, which was left by Liebig unnamed; he used the vague term invented by Berzelius, namely, catalytic. I have elsewhere recognized the two classes of germs, instead of any disputed one, without naming them.

It is now many years since Liebig first surprised me by saying that iron ores and aluminous earths were capable of taking up ammonia, and if they were breathed upon we were able even to smell that substance. He, much about the same time, made numerous experiments in order to find the ammonia of the atmosphere, and to measure its amount in rain. The result for science was great, and Professor Way continued the inquiry for the Royal Agricultural Society. Dr. Gilbert, F. R. S., among his many labors in the department of agricultural science, has made this inquiry into ammonia of rain in still later times, but I shall not at present quote his results, as this paper does not intend to go fully into the subject, but rather to indicate its magnitude and importance. The first paper I ever read to this society was on the ammonia found in peat: I was unable then to see the extent of the subject.

I shall give parts of the fuller paper without the long tables of results.

Ammonia must ever be one of the most interesting of chemical compounds. It comes from all living organisms, and is equally necessary to build them up. To do this it must be wherever plants or animals grow or decay. As it is volatile, some of it is launched into the air on its escape from combination, and in the air it is always found. As it is soluble in water it is found wherever we find water on the surface of the earth or in the air, and probably in all natural waters, even the deepest and most purified. As a part of the atmosphere it touches all substances and can be found on many; it is in reality universally on the surface of the earth, in the presence of men and animals, perhaps attached more or less to all objects, but especially to all found within human habitations, and we might also add, with equal certainty, the habitations of all animals.

If you pick up a stone in a city, and wash off the matter on the surface, you will find the water to contain ammonia. If you wash a chair or a table, or anything in a room, you will find ammonia in the washing; and if you wash your hands you will find the same: and your paper, your pen, your table-cloth, and clothes, all show ammonia, and even the glass cover to an ornament has retained some on its surface. You will find it not to be a permanent part of the glass, because you require only to wash with pure water once or twice, and you will obtain a washing which contains no ammonia. It is only superficial.

This ammonia on the surface is partly the result of the decomposition of organic matter continually taking place and adhering to everything in dwellings. The presence of organic matter is easily accounted for, but it is less easily detected than ammonia. It is probable that the chief cause of the presence of ammonia on surfaces in houses and near habitations is the direct decomposition of organic matter on the spot. If so, its presence, being more readily observed than organic matter itself, may be taken as a test, and the amount will be a measure of impurity. A room that has a smell indicating recent residence will, in a certain time, have its objects covered with organic matter, and this will be indicated by ammonia on the surface of objects. After some preliminary trials, seeing this remarkable constancy of comparative results and the beautiful gradations of amount, it occurred to me that the same substance must be found on all objects around us, whether in a town or not. I therefore went a mile from the outskirts of Manchester, and examined the objects on the way. Stones that not twenty hours before had been washed by rain, showed ammonia. It is true that the rain of Manchester contains it also, but considering that only a thin layer would be evaporated from these stones it was remarkable that they indicated the existence of any. The surface of wood was examined — palings, railings, branches of trees, grass (not very green at the time), all showed ammonia in no very small quantities. It seemed as if the whole visible surface around had ammonia. I went into the house and examined the surfaces in rooms empty and inhabited, tables, chairs, ornaments, plates, glasses and drawing-room ornaments. A (Parian) porcelain statuette, under a glass, showed some ammonia; a candlestick of the same material (but uncovered) showed much more; the back of a chair showed ammonia, when rubbed with a common duster, very little. It seemed clear that ammonia stuck to everything.

If, then, ammonia were everywhere, the conclusion seemed to be that it was not at all necessary to do as I had been doing, namely, wash the air so laboriously; it would be quite sufficient to suspend a piece of glass, and allow the ammonia to settle upon it. For this purpose small flasks were hung in various parts of the laboratory, and they were examined daily. The flasks would hold about six ounces of liquid, but they were empty, and the outer surface was washed with pure water by means of a spray bottle; it was done rapidly, and not above 20 c.c (two thirds of an ounce) of water was used. This was tested for ammonia at once with the Nessler solution. The second washing produced no appearance of ammonia, done immediately. Ammonia could be observed after an hour and a half's exposure at any rate, but I do not know the shortest period. The results of the washings were as follows; they are the average of 34 experiments for some, and 17 for others; in all 238 experiments:

	Height from floor. Ft. In.	Ammonia. M.gms.	Height from floor. Ft. In.	Ammonia. M.gms.
Front laboratory	7 3	0·013	4 2	0·019
Second landing	6 0	0·032		
Balance room	5 1	0·015	0 8	0·009
First landing	4 10	0·007		
Back laboratory	4 5	0·010	0 6	0·010
Entrance lobby	6 5	0·007		
Office	4 7	0·003		
Back yard	4 8	0·036	0 7	0·042
Back closet	2 3	0·105		
Midden	——	0·572		

The first three belonging to the working laboratory are not very regular, as we might suppose, but they never rise very high, nor do they sink to the lowest. The rest, except the second, keep a remarkable similarity, and the differences are very great. In the second there is a disturbance caused by sweeping the floors. On the other days it was requested that everything should be kept still. This of course brings in a practical difficulty, and limits the use of the test to cases where care can be used and thoughtful observation, since there are many ways by which dust may be made to interfere, even although the act of sweeping should not take place. The house experiments gave similar gradations.

The result seems to be that a piece of glass, of a definite size, hung up in any place, will receive deposits of ammonia, or substances containing ammonia, in a short time; and by washing the ammonia off with pure water, and testing it with a Nessler solution, it may be seen whether there is too much or not. It is the simplest test for ammonia yet found. Its discoverer deserves great thanks. It must not be forgotten that we may have ammonia in very different conditions; it may be pure or it may be connected with organic matter. This mode of inquiry is better suited as a negative test to show that ammonia is absent, than to show what is present. When ammonia is present there may be decomposing matter; when absent there is not. I am hoping to make this a ready popular test for air—a test for sewer gases,* for overcrowding, for cleanliness of habitations, and even of furniture, as well as for smoke and all the sources of ammonia. Of course it must be used with consideration, and the conclusions must not be drawn by an ignorant person.

How far it may be used as a test of climate is a matter to be considered also.

After this I made another series of trials with air, Nesslerizing the washings at once, and not after laborious distillings, as in former cases; the results are very valuable, showing that we obtain comparative quantities equally in this way.

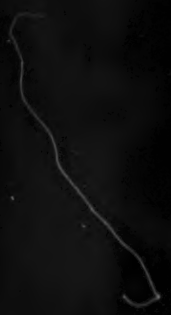
The amount of ammonia obtained in this ready way does not give exactly the same results as the more laborious methods which I have used, but it may be taken as the most convenient. It must be observed that the amount rises exactly where you might expect more organic matter to exist. The lowest is from Prince's Road, outside the town, and almost a half a mile from the extreme of the Manchester houses. The next is obtained from an empty yard, behind my laboratory, but it is still pure because there was wind and rain, and any one who observes how unusually pleasant it is to breathe air even of a smoky town during wind and rain will not be surprised. I have not yet, however, had the purest air. I shall require to make a campaign on the moors, hills, and seas before I can give numbers for this. I have not even obtained the best given on land at a distance from manufactures. All this will be done in time.†

In my office the amount is larger than outside, but the air is not so bad as it is in front, and not so good as sometimes in the front where it is open. From the back of the laboratory during the fog the ammonia was much higher, but during one day it was excessive, and a special examination of it was made in several streets. The highest amount was obtained at the front of the Cathedral, about mid-day, on the 8th of February, 1878, when the amount was 1·25, or 14½ times more than it had been found in Prince's Road, showing a considerable range:

	M.grms. of Ammonia per cubic meter of air.
Prince's Road	0·086
Open yard during rain	0·119 and 0·102
Front of laboratory	0·167 ordinary
Office	0·167
Front and back during fog	0·476
Close shut up room	0·418
Closet outside	0·800 to 0·900
Densest part of fog	1·25

MR. JOHN WILLIAMSON, whose lately published book on the ferns of Kentucky has met with such a hospitable welcome, is a young Scotch mechanic of Louisville. The illustrations, which are the distinctive feature of his book, are all of his own drawing and etching, while the fresh descriptive text shows much careful and original investigation. Inasmuch as Mr. Williamson's botanical studies have been pursued and his book prepared in the intervals of mechanical labor, it is interesting to know that he has not been a negligent workman, but that, on the contrary, he is a first-rate metal-worker. Altogether there is much to commend in the example of Mr. John Williamson.—*N. Y. Tribune.*

* A paper recently read before the Manchester Literary and Philosophical Society.

* For sewage also to a larger extent than it has yet been used.

† Since the paper was read I examined trees and stones at Skelmorlie and Wemyss Bay, finding very little ammonia.